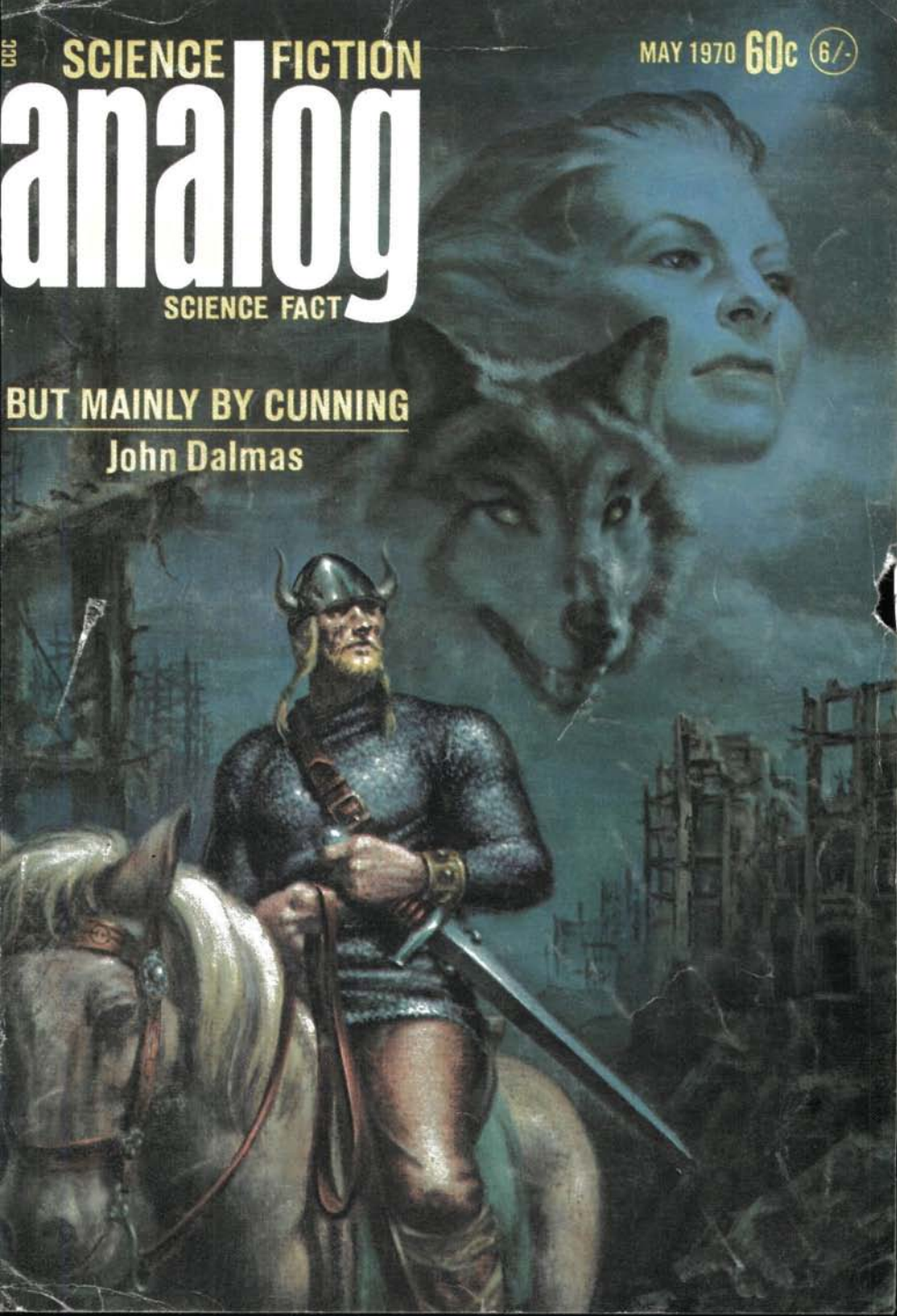

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NOVELETTES

BUT MAINLY BY CUNNING, John Dalmas 8
RESIDENT WITCH, James H. Schmitz 72

SHORT STORIES

CAVEAT EMPTOR, Lee Killough 105
HEAVY DUTY, Hank Dempsey 120

SERIAL

THE SIREN STARS, (Conclusion)
Richard and Nancy Carrigan 138

SCIENCE FACT

MR. ROBOT,
Louis L. Sutro and William L. Kilmer 38

READER'S DEPARTMENTS

THE EDITOR'S PAGE 4
IN TIMES TO COME 104
THE ANALYTICAL LABORATORY 175

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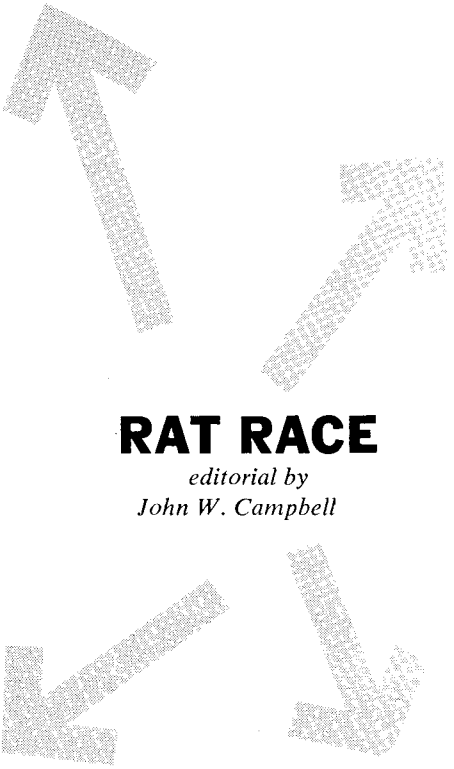

RAT RACE

editorial by
John W. Campbell

It's very difficult to bail out a boat that's got a fist-size hole in it—until you plug the leak. It's fairly easy after that.

It's difficult for Papa to build up a bank account while Mama's spending it somewhat faster than he puts it in.

And the town of Texarkana is a beautiful demonstration of why Congress has been unwilling to appropriate several millions to exterminate the rats in the city ghettos.

Texarkana, being situated right on the state boundaries between the two states, tends to get told, when it presents a problem to Texas, that "That's an Arkansas problem; take it to them," while Arkansas says exactly the same thing with "Texas" substituted for "Arkansas."

As usual, most of the time the problem is, actually, the problem of Texarkana—something that has to be handled on the local level by the local citizens.

Of course the town has the added complication that it has two city governments in two different counties of the two sovereign states. This results in the local government being somewhat less agile than the usual arthritic municipal organization.

All of which has led to a situation in which the problem definitely devolves directly on the local citizens themselves.

In this case the problem is rats. The best estimates are that there are several scores of rats for every human inhabitant of the town. This is hard on the children of the town—it makes it dangerous for toddlers to play around alone; babies in cribs are both defenseless and immobile. The rats swarm through the houses, in every building, across the "lawns" and inhabit the walls. The housewife has to use a broom handle to beat on the sides of the oven before cooking dinner, lest she have roast rat along with the baked potatoes.

I tell you, it's quite a place!

That's what the problem *is;* the

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cause is quite simple. With the decline of small farming in the area around Texarkana, many farm-raised people have moved into the town. Now on the farms, it's standard practice to throw the garbage out the kitchen door into the back yard, for the pigs to feed on. Pigs, like rats and human beings, are omnivores; pigs, however, are—when given a chance—fairly clean animals. They're fairly intelligent, courageous, and a lot more agile than nonfarmers realize. Any rats that show up in the farmyard where pigs are feeding will quite promptly be added to the protein intake of the pigs; a pig'll eat anything he can catch, which includes rats. They like snakes, too. A few hogs can keep a farmyard clean of edible garbage, rats and snakes. And if there's a stream or pond where they can bathe, as they like to, they'll be clean and produce relatively little odor in the process.

But in Texarkana, raising hogs isn't a practical idea.

The transplanted farm folk, however, persist in the idea that throwing garbage into the back yard is a practical idea. It gets cleaned up just like it usta, don' it?

Yes—but it takes a lot more rats to clean it up, and they don't do it quite as neatly.

To those people, seemingly, throwing the garbage out the back door is "doin' what comes natcherly," and they don't see any point in paying to have garbage collected, hauled away, and disposed of. They see no point in paying taxes for that sort of fanciness.

So the rats have a happy home life, with a good, substantial diet, and bear large litters several times a year.

And the citizens 'llow as how sumbody oughta exterminate them rats. "Sumbody" meaning "not me." They feel that something should be done to kill all those rats off.

Now if Congress appropriated a few millions for rat extermination, let's see how it would work in such a situation.

Using modern selective rat poisons, trapping, and such natural rat-exterminators as ferrets and black snakes and rat-terriers, an all-out campaign could probably eliminate 99.999% of the Texarkana rat population within a few weeks.

The resulting stink of decaying garbage would probably induce some of the citizens to bury their own to stop the smell—but it would, of course, also be a "come all ye hungry!" signal for all the rats in the surrounding counties.

Having cleaned up the town, presumably the extermination team would move on to the next rat-infested target. And in a matter of months the citizens of Texarkana could complain bitterly that the exterminators had done a lousy job—there would be just as many rats around as ever.

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As I say, bailing a boat with a fist-size leak in it isn't worth the effort—until you plug the leak.

The simple fact of the matter is that the people in such a place have established an ecological situation in which there is a place for an efficient, omnivorous scavenger. When such an ecological niche exists, you can depend on it that some organism will crawl in to fill it.

The problem of the rats is a problem of birth control. Remove the food supply, and they'll stop being born in endless multiplication.

Extermination is equivalent to the mathematical operation of successive subtraction—an arithmetic progression downward. But reproduction is a geometric progression; you can bet on it to win.

Texarkana stands in the middle of the great plains; it's not an "inner city" ghetto. It has nothing to do with any problem of economics, or race, or city; the problem stems from the behavior of the people of the town. They won't take the trouble to dispose of their garbage sensibly. Sure it's easier to just heave it out the kitchen door; it's cheaper than paying someone to haul it away and dispose of it, and easier than taking it out and burying it yourself.

But it's a little hard on the rat-gnawed kids . . .

Blaming the problem on Congress's failure to appropriate money for massive rat extermination problems is purest fantasy. But very popular—it puts the blame on somebody else, and prevents having to recognize one's own responsibility for the mess.

The essential point for us to recognize is that *killing off the rats won't help appreciably.* What's needed is to *change the behavior patterns of the people.*

But that's precisely what people hate. It means applying compulsion—force—to make them do something they choose not to do.

This same problem of garbage disposal applies exactly as harshly to the problem of rat-infested ghettos. It's not as clear in New York, or Chicago, or Los Angeles, because there are so many other factors at work in the immense complexity of the great cities. But the fundamental laws of ecology still apply; if you provide an ecological niche, an organism will move in to fill it. If you provide an abundant food supply for an efficient, agile, and mobile scavenger organism—mobile scavengers will move in. And on the present-day Earth, the most efficient and active mobile scavengers are the rats.

Of course, various worms, maggots and insects help the rats carry out the job—and the scavengers then supply an ecological niche for parasites such as fleas, lice, and assorted microbes.

This problem of behavior pat-

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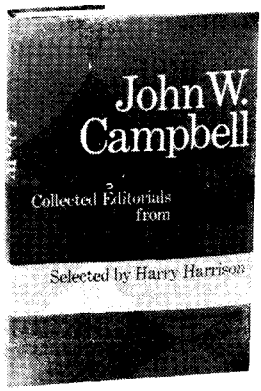

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terns leading to a bailing-out-the-leaking-boat situation applies in another area of inner-city misery—the housing shortage.

The cost of owning a house is deceptive: mortgage payments on a standard twenty-year mortgage for a relatively small house are considerably less than the rent on a small apartment. The difficulty is that the house owner has, in addition to the cost-of-direct-ownership—his mortgage payments—the cost of upkeep. This means not only the light, gas, and heating bills, but the costs of repairs. The broken step—the gutter that rusts through—repainting—the plumbing bill for the sink fixture that wore beyond repair—rewiring the house to handle the increased electrical load—replastering where the pipe sprung a leak and ruined the wall . . .

And, of course, no heating system lasts forever.

Now let's consider the landlord who owns a building and rents it to a tenant.

Let's say he has several buildings, two of which, built in different parts of the same city, cost him the same to buy. He has the same investment, he pays the same taxes, the heating bills are the same, and the tenants in each pay the utility bills.

In one apartment let's say he has a young lawyer and his wife and two children.

continued on page 176

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JOHN DALMAS
Illustrated by Kelly Freas

The strong man is one who can face realities and induce others to the same hard courage!

but mainly by cunning

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The four neoviking warriors walked their horses easily along the dirt wagon road through the woods. Although their eyes moved alertly, they seemed neither tense nor worried. All four wore black mail shirts, and deerskin breeches bound around the calves. Their moccasins came over their ankles like boots. Skins of animal heads—clan totems—were laced over their steel caps: two wolves', one a seal's and one a lynx's. Blond braids hung to the shoulders of two men, a third had red, and the smallest, a big man even so, had black. Each carried an oval shield on one shoulder, and long swords hung from their harnesses.

The leaves had fallen from the beeches and rowans, but firs were master in the low Bavarian mountains, shading the road from the haze-thinned October sun of Old Wives' Summer. A shower had fallen the day before, and tracks of a single wagon showed plainly in the loam, but around them and sometimes on them were the marks of unshod hooves. It was the hoof prints that had sharpened the riders' eyes and stilled their voices. Independently they judged that nine men had followed the wagon, and none of the four felt any need to state that obvious fact.

Topping a rise they saw the hoof tracks stretch out, where the riders ahead had begun to run their horses, and in a short distance the wagon tracks began to swerve, where the animal that pulled it had been whipped to a gallop. The northmen quickened their horses' pace, and rounding a curve saw the overturned wagon ahead.

Its driver lay beside it, blood jellied on his split skull. His horse was gone. The northmen circled without dismounting, looking down and around. Two cloaks lay against a sideboard of the wagon, one large and one smaller. The tracks of the raiders' horses left the road.

The four conversed briefly in a strongly tonal language. "Less than an hour," said the largest, a huge powerfully built youth. "Maybe as little as half an hour. With any luck they'll stop and busy themselves with the woman and we'll catch them off their horses." He rode into the woods then, eyes on the layer of fresh leaf-fall ahead, and the others followed, grinning.

The tracks led them down into a deep ravine, dense with fir and hornbeam, a trickling rivulet almost lost among the stones and dead leaves in the bottom. After drinking they slanted up the other side and followed a ridgetop where pines and birch-clumps formed an open stand. They continued along the ridge top for about five kilometers, and the tracks showed that the raiders had not stopped except, like themselves, to drink.

"Look!" The dark-haired war-

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rior spoke quietly but clearly, without stopping his horse, pointing down the slope on the east side of the ridge. Angling toward the top was another line of tracks, of leaves scuffed and indented by hooves. The northmen quickened their mounts again, until the second set of tracks joined the first. The redhead, who was in the lead now, slid from his saddle and walked back down the second set, half bent.

"Five anyway," he said. "Maybe eight or nine. Hard to tell in the leaves." He came back and swung his big frame into the saddle again. "Looks as if they came along after the others had passed." He started his horse, leaning forward and looking past his horse's neck. "And look. Here they trotted their horses, as if to catch up to the others."

He stopped and looked back at the bigger, younger man. "What now, Nils?"

The blond giant stared ahead thoughtfully for a moment. "I think they are more of the same, and enough to let be."

The redhead, oldest of the four, nodded agreement and swung his horse off the trail. Without further words the four of them urged their horses at an angle, southeastward down the ridge side.

They had ridden several kilometers through cleared farmland, the road now rutted by wagons, when they saw the village ahead, the bulk of a small castle standing a short distance past it. The huts were typical—of logs, with thatched roofs. As the road entered it they saw that here the peasants were bolder. They didn't scurry away as at the smaller clusters of huts between there and the forest, although they still drew back from the road. Beside the inn the stable boy gawped at them until a brusque word jerked him to duty and, looking back over his shoulder, he led their horses into the stable.

The rim of the sun was an intense liquid bead on the forested ridgetop to the west when they pushed open a door and entered the subdued light and complex smells of the small inn. The babble of conversation thinned to one beery voice, and then that face, too, turned toward the large barbaric-looking foreigners. The place fell still except for the slight soft sound of their moccasined feet and the sounds from the kitchen. They steered toward one of the unoccupied tables, Nils's eyes scanning the room, looking for the psi. He spotted him, a solitary lean-faced young man sitting near the wall, the hood of his homespun Brethren cloak, faded dark-green, thrown back from a lean strong-boned face. His eyes, like everyone else's, were on them. His mind was on Nils, recognizing his psi.

"What are you," he thought to

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Nils, "armed like knights, but—?" And then his mind leaped in recognition, and Nils saw the inadvertent flash of a young woman's image, tall, raw-boned and brown-haired.

"That's right. Northmen. And you are Ilse's next oldest brother."

"Yes, I'm Hannes. And you're the northman who came to her cabin in the Great Storm, the one that she had foreseen in a premonition. I recognize you from the image she showed me in her mind. Nils, is it?"

Nils's mild calm mind verified his memory.

"Stories have passed among the Brethren about the things you've done since then, you and your people. Incredible stories the Inner Circle has told. Is it true that you, yourself, killed Baalzebub?"

The innkeeper was standing beside the table. Nils ordered for himself, scarcely pausing in his silent conversation. The redhead, Sten Långresare, ordered for the other two, who spoke neither German nor Anglic.

"Yes, I killed Kazi, or Baalzebub if you prefer. Now I've come to find Ilse."

"She's had your child."

The northman's mind did not react. It was a datum.

"And she's still at her cabin."

"That's not good," Nils responded calmly. "There are horse barbarians in the hills."

Now that the alarming looking strangers were sitting quietly, the peasants had returned to their conversations and beer. Suddenly Nils began to speak aloud, in Anglic, so that they could hear, while Sten interpreted in an undertone for the other two warriors. "Brother Hannes! The horse barbarians have come; a strong force of them, we believe. They are scouting the countryside from the hills. What defenses are there here?"

The sun-browned psi stood up slowly, surprised and puzzled by this unexpected speech. Conversations had died abruptly as worried faces turned toward the neo-vikings. Hannes spoke carefully, so that the peasant with the most uncertain knowledge of Anglic could follow his words. "The baron here is Martin Gutknecht. He is a mild man and an honest lord, but well known for his skill in fighting. He keeps a dozen knights now, all hard, fierce men. A half dozen others were killed or maimed in the battle on the Elbe. Since then he's kept a few dozen other armed men at the castle, as well."

"And who will protect the peasants if the horse barbarians come suddenly, like ravening wolves, with curved swords for teeth, to attack the villages? Maybe a hundred or more of them?" Nils's mind caught the shock of fear from the peasants.

Irritation flashed through Hannes's mind. "Why did you say

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that? It was vicious," his mind accused. But as he thought it he realized that there had been no tinge of viciousness, or sadism, in the northman's mind, and that the character pattern he read would not support that interpretation. But he neither corrected himself nor apologized. Either would be redundant to another psi. Instead he stood there, gazing with his mind at Nils's. "Ilse described what your mind is like," he said at last. "Now I see more clearly what she meant. It doesn't leak. Aside from the character pattern it tells me only what you want it to. And yet you don't seem to screen; it's different and more effective than that."

Nils smiled slightly, and as the innkeeper approached with roast meat and a stew of vegetables he returned to the point. "We've seen signs of two bunches, one of nine and the other possibly as large. They behaved more like scouting parties than like vagrant bands. They didn't even stop to rape the woman they caught." His mind pictured the wagon for Hannes, with the two cloaks and the dead man, a picture more precise than any intentional memory Hannes had ever seen. It was as if the northman had complete access to his memory bank and his subconscious. His sister's mind was the finest he'd ever known before, but it wasn't like this.

Nils's calm thoughts continued relentlessly. "That suggests a strong force of them nearby. And they are fighters by nature. It's their way of life. As individual fighters they are possibly as good as your knights; they'd be even better if they had more self-control. As tactical units they're generally not as good. A village is a better place to winter then the forest, and they're reckless men. If there are as many as a hundred of them, or even fifty, they can easily take and hold the village. The men in the castle won't be able to drive them away. The knights are too few, and outside the walls the men-at-arms aren't nearly a match for horse barbarians. But the peasants stand in awe of the Brethren. If you tell them to take their bows and defend themselves, they will."

"Defend themselves? But you just said the men-at-arms would be no match for horse barbarians. Surely they'd slaughter the peasants."

"They'll be slaughtered anyway—those that aren't inside the castle. But from their roofs they can take some of the enemy with them."

Night had fallen, and the air already felt frosty. The moon was two nights past full and would not rise for a while. In the darkness the northmen rode slowly on the short stretch of unfamiliar road between village and castle. Their horses' hooves, thudding softly on the earth, emphasized the stillness

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now that summer's night sounds had passed. In front of them the castle stood black against a star-strewn sky. Only a few windows in the gate tower and the keep showed lights above the wall.

Nils reached with his mind and sensed the minds of the gate guards. As he came beneath the wall he was near enough to see the spots on the cards through their eyes, the rough plank table. He sensed thoughts in German without knowing their meaning, felt their emotions which were quiet now and poorly defined. At the gate he drew his sword and hammered the hilt sharply against the timbers three times, calling in Anglic, "Open the gate!"

The immediate responses were starts, and flashes of irritation, followed by suspicion, probably with the realization that the hail had been in Anglic rather than German. Nils could not read the German thoughts, but his mind presumed them. Except for the Brethren and foreigners, who would hail in Anglic? And would one of the Brethren ever use such a preemptory tone? A torch was held over the battlement and a dim face looked down from an embrasure twenty feet above them. "Who are you and what do you want?"

"We're northmen. We want to see Martin Gutknecht."

"Come back tomorrow, when the gate is open."

Nils pounded again, almost violently, bellowing, "Open! Open!"

"Peace, peace," the voice hissed from above. "If your racket disturbs the baron, you'll wish you hadn't got in. I can't let armed men in at night, unknown men, without his leave. Why can't you wait until morning?"

"Two reasons," said Nils, his voice suddenly mild again. "First, northmen don't wait unless they want to, although they'll wait forever if it suits them." With each mention of "northmen" the man's mind had jumped with recognition, Nils noted. Apparently stories of them had reached here from the war in the Ukraine. He continued. "The second reason: we have information for your baron of horse barbarians near the district. We will either tell him what we know right now, or we'll leave and your blood can mark your ignorance. Your scurfy district here means nothing to us that we should cool our heels."

Sten grinned at Nils, chuckling in his throat as the torch was withdrawn, and spoke softly in the northern tongue until their companions, too, wore wolfish grins. Then they waited silently for a span of minutes. At length Nils sensed the gateman approaching, with others, one of them hard and confident. The baron, or more probably his marshal—if he had a marshal.

A narrow gate opened beside the

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main gate, and the gateman beckoned to them. It was almost too narrow for a horse to pass, and low enough that the northmen dismounted and ducked their heads to enter. The other three loosened their swords in their scabbards, but Nils, finding no treachery in the waiting minds, had taken his horse's reins and preceded them. Inside the wall the tunnellike gateway was no wider, and where it opened into the courtyard there was another gate, a raised door of heavy bars. In the courtyard a cluster of knights waited, dimly seen. Nils's glance counted eight, and he looked at the one whom he sensed was the leader.

"Come," the man said curtly, and turning, led them, the other knights falling in behind.

The keep loomed in the darkness, perhaps twenty meters in diameter and three levels of rooms in height, Nils decided, with a dungeon below the ground level no doubt.

Martin Gutknecht's audience chamber was small, in keeping with his position as one of the lesser nobility. He was a freckled small-boned man of medium height, but chunky and strong looking. Although he met them seated, the elevation of his chair allowed him to meet Nils's eyes on the level.

"So you are northmen. The Saxons told us about your feats against the enemy far away in the east. But they also told us that you had gone south from there, into unknown lands. What are northmen doing in Bavaria?"

"I've been in Bavaria before, as a wanderer. Now we've come to find a seeress who saved my life after the Great Storm. We plan to winter in the land of the Magyars and then pass down the river Donau to the sea, where our people are going."

"Ah. To the land of Baalzebub. Then it's true that the northmen defeated his army and killed him. You must be mighty warriors."

"Our warriors are chosen young for strength and quickness, trained 'til no one can match their weapons' skills. But there were a lot of the enemy. We won mainly by cunning. Now Baalzebub's orcs are dead, or fled, and the last time I saw his head it was lying beside a Ukrainian marsh. His horse barbarians are still plundering Europe though, in spite of the beating you gave them at Elbestädt, and you don't need to go farther than the hills west of this valley to find some."

"My man told me you had news of horse barbarians near the district. Where, and how many have you seen?"

Nils described what they had seen and what they had made of it, and the baron indicated his acceptance of their interpretation by not disputing it. "But they can't take

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the castle," he answered. "A few score men can hold it against hundreds, unless the hundreds have siege engines."

"They don't need the castle."

"But they can be driven out of the village."

"Not by you. There aren't enough of you."

"But my lord, the graf, can drive them out. His vassals include three barons besides myself, plus his own knights."

"How many men?"

Martin Gutknecht grew thoughtful. "Five dozen knights, maybe. And bowmen to support them. We all took losses at Elbestädt. In fact, the old graf died there, and his cousin is the graf now."

"Five dozen? Not enough," Nils said, sensing the same thought in the baron's mind. "Not if the horse barbarians number much over a hundred."

"But the graf could get help from others."

"How long,"

"What,"

"How long would it take that help to get here?"

"Two weeks. Maybe three. But we could easily hold out that long."

"You could. But what about the peasants? Could you bring them inside the walls and shelter and feed them? The weather could turn bad any time now. The horse barbarians will take the village, kill the men and take the women captive. And if an army comes to relieve you, and it's strong enough, they may not even stay to fight. They may ride into the mountains and come back when the graf has left, or go somewhere else and take another village. That's what I'd do."

"And what do you want me to do?" The baron's voice reflected the anger of frustration that Nils read in his mind. "You say I don't have the strength to stop them but I don't have the space to keep many of my people inside."

"Bring in as many as you have room for. Put sentries out with horns. Have the peasant men climb on their roofs when they hear the horns, and use their bows. And give them whatever swords you can. They may not be of much use to them as weapons, but they may help to stiffen their spines."

"Swords! But it's against the king's law to give peasants swords. And I can't call them men-at-arms; I already have as many as the law allows."

Nils didn't answer.

The baron sat down again, thoughtful. "Surely you don't think the peasants could hold the village." It was a statement, not a question.

"No. But there'd be fewer horse barbarians when it was over. And the peasant men will be killed anyway. It's not just a matter of this village though. There are thou-

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sands of horse barbarians plundering through Europe, and your troubles with them won't end until they're dead, or driven out. When there were a few large armies of them your kings marched against them, and they stood and fought, and you beat them. But now that they're a lot of scattered packs you don't know what to do about them. After Elbestädt you should have kept after them and hunted them down, but you demobilized and came back to your castles to lick your wounds. Now you can't defend the villages because you don't know where they'll strike next. The peasants—"

"But would the peasants fight? They're only peasants after all."

"Talk to the Brethren," Nils answered. "They know the peasants better than anyone else does. There's one stopping in the village now, a Brother Hannes."

Martin Gutknecht stared thoughtfully past Nils, the discourse within his mind a slow complex pattern of German. But if the thoughts were unintelligible to Nils, their tenor was not, and he was satisfied that the baron would follow his advice, at least as far as bows and arrows were concerned.

The brown eyes focused on Nils. "Well, northman, I'm not used to someone else doing my thinking for me, and I'm not overly fond of it, but I thank you just the same. Will you and your friends stay here tonight? I can feed you better than they would at the inn, and the straw in the beds will be fresher."

"Our thanks, Baron, but we'll sleep in the open. Cream draws flies. Who knows? The attack could come tonight, and we don't want to be trapped in the inn and butchered, or in the castle and delayed." He held out a huge hand. "We wish you luck, and the blood of your enemies."

Before the sun passed the meridian the four warriors had left the main road and ridden westward on another toward the wild forest that began with the hills. The valley here was wider, and south of the crossroad they had seen another castle in the distance. The October sun was warm, almost hot, and although they were used to wearing mail, and to sweating, it felt pleasant to ride into the shade at last. At a suggestion from Leif Trollsvard, the dark Norwegian, they swung out of their saddles and strode along, leading their horses up the slowly climbing road, stretching their own legs and giving the animals a rest. Here the road was little more than a trail, wide enough for a wagon but humpy with stones and outcrops of bedrock.

In their own lands they were more used to going on foot or skis than on horseback, and they hiked for three hours in unbroken forest, the road curving more north than

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west. Soon after they'd mounted again, Nils led them off the road at a blazed tree and along a little path that led to a cabin. He held up his hand, stopping them as soon as he could see the cabin through the trees. His careful eyes saw nothing wrong. His subconscious, remembering perfectly, comparing in detail, saw nothing different that could not be accounted for by the passage of time, by the change of seasons from one winter to the following autumn. But he knew unquestionably that something was seriously the matter.

They sat without moving, all but Nils annoyed at the occasional movements of their horses, their eyes carefully examining the cabin and the woods around it, their ears alert for meaningful sound. Then Nils whispered. "By the cabin. Horse manure."

They saw it then. After a minute they rode slowly forward again, tautly alert, arrows nocked on bowstrings. The place seemed deserted now. Finally Nils and the blond Göt, Erik Blodsraseri, dropped from their saddles and approached the open door. Suddenly raising his shield, Nils darted through, half crouching, Erik ready to follow. The cabin was empty. He spoke and the others came in.

The shutters were open, and the autumn sunshine filtered through the thin-scraped deerhides stretched over the windows. It was obvious that the place had been used by horse barbarians, apparently in a rain for they had voided in one corner. And blood had dried on the split legs of the floor. The expressions of the three mirrored their separate characters as they looked from the blood to Nils.

Erik's showed controlled rage, and his eyes gleamed in anticipation of vendetta. In Leif Trollsvärd's darker face the jaw muscles were knotted, but his eyes showed concern for Nils. Sten Långresare, keen-minded and long on experience, merely watched his big young friend, to see what his reaction might be, for he had decided some time ago that Nils Järnhand was a new sort of man whose acts he could not yet predict.

Nils walked slowly through the cabin's two rooms, his eyes missing nothing. Then all four went outside, examining the ground.

"They were here yesterday and at least once before that," he said at last. "Maybe some will come tonight. We'll bed within hearing, in a thicket, with our mail on."

As they led their horses downwind of the cabin, into the forest, they smelled rotting flesh. By a clum of hazel they found the body of a baby, skull smashed, its flesh gnawed by polecats. In a draw behind the cabin they found Ilse's spring, and the tracks where the horse barbarians had ridden up the brook. They staked their horses some distance away and returned,

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holing up in a grove of old firs where a ring of sapling growth screened them from the nearby cabin. They took dried meat, cheese, and hard rye bread from their saddle bags and ate without talking. When they were done they stretched out on top of their sleeping robes and relaxed like wild animals.

Soon the sun had dropped behind the crest of the ridge in back of them. All heard the voices at the same time, loud and in a language that wasn't German. They lay quietly, listening to the careless sounds; this time the horse barbarians came down the draw above the spring. Soon the voices were lost within the cabin's walls.

Nils spoke for a minute in an undertone, answered by nods and narrow-eyed grins. They buckled on their harnesses, took swords, shields, and bows, and slipped through the trees to where they could see the cabin clearly. It still was full daylight, even in the shadow of the ridge. The horse barbarians had tethered their horses on leather ropes, to browse the twig ends of the brush, and after a brief intent examination of the surroundings the northmen decided that all were inside. The smoke of a young fire was starting from the stone chimney.

Each side of the cabin had openings. There was a door in front, and one in back, and each side wall had two windows, one into each of the two rooms. Leif Trollsvärd, an arrow nocked, took a position from which he could cover the back door and the windows in one of the side walls. Sten Långresare knelt behind a tree diagonally opposite, covering the front door and the windows in the other side. Erik slipped quietly across the narrow strip of open ground to the side of the house and around the corner, stationing himself beside the back door, his teeth bared in an ugly grin.

A moment later Nils appeared from the other side. He had a dry fir branch in his right hand, one end wrapped with blazing birch bark. As he ran up to the wall he threw the branch well up onto the shake roof, then darted around the corner, drawing his sword. He could sense the startled intentness inside; they had heard the thump of the torch.

Just as Nils reached the side of the door a swarthy youth stepped out, started, and jumped back, but the sword stroke caught him as he moved and he fell backward into the cabin with his rib cage cloven. The short shouts from inside meant nothing to Nils, but the thoughts that reached him were of anger and alarm. He stood, shoulder to the wall, waiting for another, but none came. There were sounds of men grabbing weapons and putting on mail shirts, and Nils sensed one of them standing

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beside the wall, just inside the door, waiting for someone to try an entrance.

"One down!" Nils shouted.

They were talking inside now, urgently and with undertones of fear. Through Sten's eyes Nils saw flames begin to blaze up around the torch, but those inside were not aware of it yet because of the loft that separated them from the roof. From the rear of the cabin a brief clashing of steel sounded.

"Make that two down!" came Erik's cheerful bellow.

The man inside the door, unknowingly, enabled Nils to watch a lean youth draw a knife, slash the sides and top of one of the deerskin window coverings and thrust his head and shoulders through. Uttering a bleating cry he fell backwards, and with a convulsive jerk pulled an arrow from the muscles of his neck. He rolled over onto hands and knees, retching, blood gushing from the wound and from his open mouth, then collapsed forward on his face. With an abrupt roar another man ran and hurled himself headlong through the empty window. Rounding the corner he ran at Nils, drawing his sword, fell forward to his knees, rose slowly, and fell again as a second arrow drove through his mail shirt.

Nils's mind counted the consciousnesses inside. "That's four," he shouted. "Two for Sten. There are six more left." A victorious whoop came from Sten's position among the trees.

Inside, too, there was talk, and one horse barbarian stationed himself by each window and door. Their tough minds broadcast worry and uncertainty, with various mixtures of anger and fear. They had no clear idea of what they were up against, and no concerted idea of what to do beyond defending themselves. Again through Sten's eyes Nils watched the flames on the roof, burning higher now and starting to spread.

Suddenly there was a mental shock of alarm from inside, and quick words of instruction. One of the window guards left his post and Nils's mind went with him up the ladder, raising the trapdoor and gazing into the dark loft. Above he saw the bright flames burning through the roof. At that moment some burning material fell near him and the man dropped from the ladder to the floor below, yelling.

A few hoarse words drew them all into the front room; Nils in turn shouted to Erik. All six charged at the open door. Nils's stroke caught the first as he emerged, sweeping below the shield and cutting his legs from under him. The second hurdled him before Nils could strike again, and attacked with berserk rage while a third ran out behind him. From inside came oaths and grunts as Erik fell on them from behind.

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Sten put an arrow in the third man out, while Nils, weathering the initial fury, killed his assailant and went through the door crouched behind his shield, to help Erik.

Erik needed no help. One lay struck dead from behind and a second was down, bleeding and helpless, cursing. The blond Göt stood watching through the open window: the last of the enemy patrol had jumped through it and was running into the woods, holding his right shoulder where an arrow was embedded. They watched a grinning red-haired figure pursue him out of sight among the trees. In a minute Sten reappeared, waving his bloody sword, and they left the burning cabin.

When Nils's eyes opened they focused first on the skeletal crown of a beech tree, its major limbs dimly resolved against the night sky. A few stars of larger magnitude were visible between the black masses of fir tops, and moving his head, he could see the gibbous moon past the meridian, telling him that morning was not far off. Its pale light washed patches of ground and filled others with dense black shadow. Forty meters away, between the stems of trees and brush, he could see dull red coals where the cabin had burned, and his sensitive nose could smell it. Frost from his breath coated the fur at the upper edge of his sleeping robe.

He had wakened wide, not from the frost, or the moonlight, but from something that lay calm and watchful in his mind. Without ever having experienced it before he knew it was the consciousness of a he-wolf, probably one of Ilse's familiars, but he did not know how to communicate with it.

The wolf had sensed his waking telepathically, and had waited until Nils was aware of him. As if it had sensed Nils's psi power, even when he had been asleep—as if it had recognized him, or recognized his mind. And then there was a picture of Ilse in its mind, for Nils to see. The picture zoomed in on Ilse's face and seemed to go right into her mind, where there was a physical and mental image of Nils. And with that as an almost instantaneous background the picture was again of Ilse, hands tied, being taken away by a patrol of horse barbarians. As Nils sat up in his sleeping furs the picture became one of a large man, Nils, on horseback, with undefined representations of companions, following a large wolf through the forest.

The picture faded and the emission of the wolf's mind changed to a quiet formlessness, as Ilse said his own did, without idle imagining and symbolizing. And there was no image of direct optical experience, indicating the eyes were closed. Nils lay back down then, going to sleep almost at once, and didn't wake until the gray wash of dawn.

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When the sun was two hours high, the four warriors lay beneath the low branches at the edge of a sapling fir thicket. The horse barbarian bivouac of tepeelike tents lay along the gentle lower slopes of a ridge. Secure in their strength and hidden site they were careless about adequate sentries, just as they had been in the Ukraine months before.

"Leif, here's a chance to bloody your sword," Erik breathed with a grin. "But you'll have to go down alone, seeing as how you made us do all the work yesterday."

Leif Trollsvärd looked back over his shoulder and grunted an obscenity. Sten chuckled. "They were afraid to go in his direction; they remembered him from last summer. And when did you start considering fighting as work?"

Nils ignored their whispered chaffing. They were within the range of normal telepathic pickup from the camp now—close enough that loud voices could be heard. He had intended to reach Ilse with his mind, but now he did not dare a forceful telepathic call to get her attention. For there were two psi minds in the camp—hers and one that belonged to a horse barbarian. They had counted the tents, more than forty. Well over one hundred men and possibly two hundred. "This place is dangerous," he whispered. "There is a psi down there." With that all four crawled into the thicket and slipped away.

The castle was much larger than that of Martin Gutknecht, and had a moat with green billows of algae. The gate stood open in the sunlit morning as the neovikings walked their horses across the drawbridge. The gate guards scowled at the strangely garbed and equipped riders but did not move to stop them. As the warriors approached the great squat keep, the two guards at its entrance lowered their pikes and one called down to halt. "Who are you and what do you want?"

Nils stared up the stone steps at them, one enormous hand spread on a thick thigh, making the most of his size and imposing physique as they stared. "Who is your master?" he responded.

This question for a question stopped the slow-witted guard. After a moment he answered, "The graf, Karl Hauptmann."

"Tell him four northmen are here to see him, with information about a strong force of horse barbarians in the county."

The sun-browned face stared suspiciously at the big northman, jaws working with indecision. Nils helped him.

"Move! Or would you rather be staked out in the sun and flayed?"

The guard turned and passed reluctantly through the open door. His partner's mind squirmed with discomfort at being left alone to face the four big warriors, a discomfort which the three could read

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in his face as certainly as Nils read it in his mind.

"At home men like that would be thralls," Leif Trollsvärd said.

"That's about what they are here," Sten answered.

The remaining guard stared at them, perplexed by the unfamiliar tonal syllables. He knew German and Anglic, but had never heard any other language and was uncertain whether this was truly speech or not. After several minutes a burly knight came out of the dim interior and squinted down at them in the bright sunshine. He snapped fast words in German, and they sat looking impassively up at him until he repeated in Anglic. "Who are you and what do you want?"

"We are northmen and want to see the graf," Nils said dryly. "We've seen a large force of horse barbarians near the district of Martin Gutknecht."

The knight sneered. "Show a skin-clad savage a peasant riding on an ox and there's no telling what he'll think he saw."

The usually imperturbable Sten rose in his stirrups and had his sword half out before Nils put a hand on his wrist and spoke softly in Swedish. Then, turning back to the knight, Nils said with mild calm, "Then let us tell him what we think we saw."

Without saying anything more he led them inside and to a throne room some fifteen meters long. Entering, they passed two guards with pikes and swords who stood by the open door. Five mail-clad knights stood on the dais near the throne; three were breathing hard, as if they had hurried to be there. Karl Hauptmann sat upright and hard-faced as the marshal, followed by the barbaric-looking warriors, strode to the foot of the dais and stated the particulars in German.

Nils realized it had been a serious mistake to come here. He sensed cruelty and ruthlessness in the graf, and a pathological suspicion of foreigners. The graf looked at them.

"Northmen, eh? What is this about horse barbarians?"

"There's a large force of them, between one and two hundred, camped in the mountains near the district of Martin Gutknecht. We think they plan to take his principal village."

The graf's emotional pattern was complex but ugly, but his speech, though curt, was civil. "Why do you think they'll try to take Doppeltanne?"

Nils sensed here a paranoid who might easily have them attacked on the spot if he thought it safe. And, lacking any tactical advantage, the odds of nine to four did not appeal to Nils, especially with the two door guards behind them. He stated his answer matter-of-factly, in a voice of utter confidence. "First, I didn't say 'try.' There is no question of their ability. Second, they'll need food

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and shelter for the winter, and the village has both. Third, it's near Gutknecht's district where they're camped. And fourth, they're in tents, making no effort to build huts for the winter."

"And why should I listen to you?" The graf's control cracked for a moment. "You are foreign barbarians yourselves. What are northmen doing in Bavaria, unless—?"

Nils saw a chance to dull the man's suspicions. "We're going to Baalzebub's land. Our army beat his and killed Baalzebub himself. Now we're going to claim his country."

"But we'd heard that you were passing far to the east, far east of the Czechlands." The graf stared intently at Nils through narrowed eyes.

"The rest of our people are. The four of us have come this way though, to see to some business."

"What business?"

To say "a woman" might amuse the graf, and relax him, or it might make them seem ludicrous and weak. Worse, it might seem so trivial as to be an insulting lie. Hundreds of dangerous miles to see a woman! On the other hand, to say arrogantly, "our own business," might offend him dangerously, but it might also awe him with their confidence and make him cautious.

"Our own business."

The graf darkened, and turning, spoke to his marshal in German for a moment. The marshal glanced grimly at the northmen and left. The other knights tightened.

"Then why do you come to tell me about horse barbarians? They're no business of yours, are they?" There was a note of triumph in the graf's voice.

"Maybe they shouldn't be. Not here at any rate." Nils looked at the others. "Let's go," he said in Swedish. "But be ready to fight." They turned to leave.

"Wait!" The graf stood up. "You say you saw their camp. Where is it?"

They stopped. "In the mountains west of Gutknecht's district," Nils answered. "Within the forest there are three main ridges between the valley and their camp. They are camped along the east foot of the fourth ridge. Or they were. They could be in Doppeltanne by now."

He's stalling for time, Nils thought.

Sitting, the graf asked more questions, about the condition of the enemy and their horses, and what Nils knew of their tactics. But after several minutes he rose abruptly. "Thank you, northmen, for your information." His eyes were like chips of flint, and a small smile played around the corners of his mouth. "And travel in peace."

Nils nodded and the four warriors started toward the tall broad door of the chamber. Halfway

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there Nils sensed that the knights were moving; glancing back he saw them sauntering from the dais. Though seemingly talking casually, they were taut inside, and nervous. Nils paused briefly in the doorway, then started down the wide corridor.

"When he sent his marshal out I sensed treachery," Nils said rapidly. "After that he was stalling for time. The ones behind us are one jaw of a trap."

The short flight of stairs leading down to the entrance of the keep was only half as wide as the corridor—a possible death trap. Just short of the stairs Nils quietly said, "Stop," stepped to a window and leaned out on his stomach through the thick-walled opening to scan the courtyard. Outside stood a phalanx of bowmen with several mounted knights, facing the keep.

The knights following the northmen had continued a few paces and stopped uncertainly. "Take them," Nils said, and they fell upon them.

At the sounds of fighting and the shouts of the knights, the entrance guards below began to shout. The unexpectedness and ferocity of the northmen's attack overran the knights, three of whom fell while the others gave way and let them pass. One of the guards at the throne room door dropped his pike and ran into a side corridor, while the other, cursing, stepped quickly through the door and tried to close it. It burst open in his face, throwing him to the floor, as the four warriors rushed in.

The graf stood in front of his throne, drawing a short sword, but Nils met him at the foot of the dais and bisected him casually in passing, then led them through a tapestried doorway behind the throne, and up a flight of stairs. This took them to a suite of rooms above, where they found a woman, obviously the grafin, and a boy in his early teens. Startled, the boy drew a knife, but Leif grabbed his wrist and the knife clattered on the flags.

Erik covered the stairwell then, and Leif and Sten held their two prisoners while Nils gagged them. They could hear someone shouting in the throne room, and, while Nils snatched a bow and quiver of arrows from the wall, angry voices and shod feet sounded from below. Strong-arming their prisoners, they hurried out of the apartment into another corridor and from it into a climbing stairwell that wound within the outer wall.

Voices surged into the corridor they had just left, and Nils shouted down in Anglic to stop, that they had the grafin and the boy. Pursuit stopped, although the voices only paused, and the northmen went on up the stairs with their two prisoners until they emerged onto the open top of the keep. Erik and Sten stayed by the trap-

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door, tying the woman with strips of her petticoat. Leif pushed the boy ahead of him to the parapet and lifted him bodily into an embrasure where he could be clearly seen, a powerful fist holding him firmly by belt and jerkin. Nils laid the bow and quiver against the parapet and leaned through an embrasure next to the one the boy was in.

A growing crowd stood below in the courtyard, including some of the archers and a knight, but their attention was on the entrance and they had not yet seen the figures in the embrasures atop the keep. For a long minute things hung like that, as if the world had slowed down, until a knight jogged shouting out of the entrance of the keep, followed quickly by others, and all eyes turned to the top. Briefly there were angry shouts from the courtyard, but Nils kept still, monitoring emotions, until a waiting almost-silence had settled. Then he spoke, loudly so that he was clearly heard twenty meters below.

"We came in peace, to tell the graf of an army of horse barbarians camped within the country." A babble of voices rose that Nils waited out. "As our reward he tried to have us murdered." He paused. "Now he is dead, and we have his wife and boy hostage."

Although the crowd remained quiet, Nils stopped until he could sense unease below, and the beginning of impatience, then called down again. "Who was the marshal of the old graf? The graf killed at Elbestädt? Step forward, if you're here."

The faces below turned to a tall square-shouldered knight, who stood looking grimly upward before striding out in front of the archers.

"And the man who is marshal now. Let him step forward."

The burly sneering knight came into the open beside the other.

Without speaking, Nils stepped back from the embrasure, out of sight, nocked an arrow and bent the bow. Then, stepping up to the embrasure again he let the bowstring go, and the new marshal fell with an arrow in his chest.

No one else moved, and in that instant of shock Nils shouted down, "The marshal from before is now the ruler of this castle until the king names a new graf. Come up and parlay with us, and then we'll leave."

The northmen spent the night in the forest's edge on the eastern side of the valley, partway to Doppeltanne. At dawn they rode on, gnawing cheese and hard bread as they rode through frost-rimed grass. The timber's edge was grazed and open, alternating between heavy-limbed oaks and groves of gray beeches as hollow as chimneys, their fire-scarred bases doors to squirrels and pole-

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cats. After some hours they could see the castle of Martin Gutknecht, and then Doppeltanne. Cattle foraged in the stubble-fields, tended by boys with long sticks, so the neovikings rode out openly and came to the castle before noon.

The sun was warm now, and outside the walls sweating peasant youths swung swords in a clumsy parody of drill, rasped by the cutting tongue of a hard-eyed knight. Rapt children and glum old men stood watching. In the courtyard were dozens of peasant women, squatting around small fires, preparing the noon meal. Shelters of poles, bark and hides were being built.

The northmen found the baron in the armory, sparring with his marshal with shields and blunt swords. He lowered his club and turned a sweating face to them. "Too bloody crowded to practice in the courtyard." He wiped his face with a rag. "I thought you'd be long gone. Do you have any news? I sent men out yesterday, good hunters, and they found tracks."

"If they'd been with us they'd have seen more than tracks," Nils answered. "We hit their camp a few hours west of here. There are more than a hundred of them, probably closer to two hundred. We took the news to the graf, and frankly we thought we might find the village taken by now. It looks as if their camp may be not so much an attack base as a base for reconnoitering a wide territory. But even if that's the case, the fact they're located so near can't be very comforting. We'll go out and see what we can learn, which may not be much—after lunch, that is. Is Brother Hannes around?"

"He may be in the village. We talked two days ago, and then we both talked to the peasants. Since then he's been riding around the district encouraging them. And he's the one who chose the men we issued swords to. He says they're the likeliest to fight."

"The Brethren know the people's minds as if they could look into them," Nils commented. "I'll go look for him. With your leave I'd like to talk to both of you together."

As soon as Nils rode out the gate he sensed Hannes, and found him watching the peasants drilling. Hannes was clearly depressed; he knew that soon many of these people would die. Turning at the approach of the warriors, he sensed at once that Nils brought bad news, and guessed the worst.

"Dead?"

"No. Prisoner."

"Gentle Father Jakob." Among the Brethren and all the Psi-kin the memory of Jakob Anton Norbu was revered. He had kept psi alive in Europe during the terrible days after the Great Death, more than seven centuries earlier. The lean telepath breathed his

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name now partly in gratitude, partly in pain.

"I figure to get her back," Nils said. "Now let's go talk to the baron. We have plans to make."

Hannes looked at him with sudden appreciation. There was no emotional content to anything he had heard Nils say or think—his emotions had to be a lot different than other people's, just as his mind was. But he knew that if it wasn't for Ilse, Nils would have left his warning and been two days gone from the district by now. Hannes held up his hand to Nils and, half jumping, half hoisted, mounted behind the warrior.

Nils stepped back from the rough map he had drawn. "And that's where their camp is from here, as best I can tell. But they won't stay there much longer. They'll either come here or they'll go somewhere else. We'd better assume they'll come here."

"By day or by night?" the baron asked.

"I've never seen horse barbarians start anything at night, although that doesn't mean they won't. There are different tribes and different tongues, and this bunch may be different from those we've fought before. Or they may have changed their tactics since last summer. But it's my guess they'll attack by daylight. And after they take the village they'll probably get drunk. If Hannes and Sten took your armed peasants into the forest east of the valley after dark tonight, and camped there—"

After eating and replenishing their saddlebags, Nils, Leif and Erik rode several kilometers south down the road, to where a finger of forest approached it on a low spur ridge from the west. As soon as they could they angled southwesterly, hoping to lessen the chance of encountering enemy scouts. Then gradually their course curved, until, near sundown, they were following the upper west slope of the fourth major ridge, headed north.

The horse barbarians were raiders from the deserts, steppes, and arid mountains of the middle east, whose tradition was open mounted attack, or simple ambush. The neovikings, on the other hand, were raiders of the Scandinavian forests, whose style was cunning and stealth. And at home they'd made an important part of their living hunting on foot with bows. Thus their sensors missed little and their minds remembered and correlated what they saw and heard and smelled, like the Iroquois of eleven hundred years earlier. So this stretch of ridge was familiar to the northmen, though they'd seen it only once before and from a different approach. After a bit they rode into the bottom of the heavily wooded valley west of the ridge

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and tied their horses in a stand of young fir that was littered and almost fenced by the blown down bones of ancestors. It was not the kind of place a rider was likely to wander into.

Then, on foot and with their sleeping robes in bundles on their backs, they climbed back up the long slope as dusk began to settle, and slipped toward the enemy camp. Nils sensed no sentry. When he decided they were approaching the range of normal telepathy he left Leif and Erik in a tangle of blowdown and moved quietly on until he was receiving the casual, though to him unintelligible, thoughts of the Turkic tribesmen nearby. After determining his line of withdrawal, he lay beside the slightly raised disk of roots and soil of a pole-sized fir that had partly uprooted and lodged in the top of a beech. Come morning it would give nearly perfect concealment, if needed.

His mind stilled, as no other human mind could, as undiscernible to a watchful psi as possible. Soon it was dark, and he saw yellow campfires dancing nearby. In his robe his body was relaxed as if in hypnosis, and his mind merely received, correlated and stored, without thinking about anything.

After a time he permitted himself to sleep. A part of his brain monitored the environment, ready to waken his consciousness if necessary.

He awoke without moving and let his eyes sweep the gray-lit woods within their range, his ears and psi sense alert, his subconscious carefully sorting sensations. He was aware that the two psi minds in the camp were awake too, along with many others. Ilse and the other psi were together, but too far away from Nils to receive passive optical impressions from either of them. From the male Nils recognized the patterns of a strong but undisciplined mind.

She was teaching him Anglic.

The light was growing stronger. Slowly Nils slid into the dark opening under the tipped-up roots. Breakfast fires were being lit. Soon early-morning taciturnity disappeared among the enemy tribesmen as fires and movement warmed them. Their eating took some time, and Nils could hear them talking and laughing, the sounds mixed with the patterns of telepathic emissions that were their functional accompaniment.

He continued to lie there, his mind quiet, focused on the two psis, the other minds relegated to background. He believed that he knew which tent was theirs. Then a man came out of it and the bearings of the two minds separated as he walked through the camp. Soon men and captive women began to strike tents, rolling them into bundles. Others trailed down the gentle toe slope toward a long meadow that bordered the creek in the val-

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ley bottom, and returned leading strings of horses.

Nils saw Ilse then, pulling down the tent, folding and rolling it. The man returned when she was done and helped load it on a horse. Within an hour all gear had been loaded. The horse barbarians mounted, their voices loud and boisterous at the prospect of action. The psi led them in a loose column through the trees, eastward toward Doppeltanne. Pack animals and spare mounts followed. A score of women sat the nags of the string, bareback, waiting while the pack train moved out. Behind them were mounted guards.

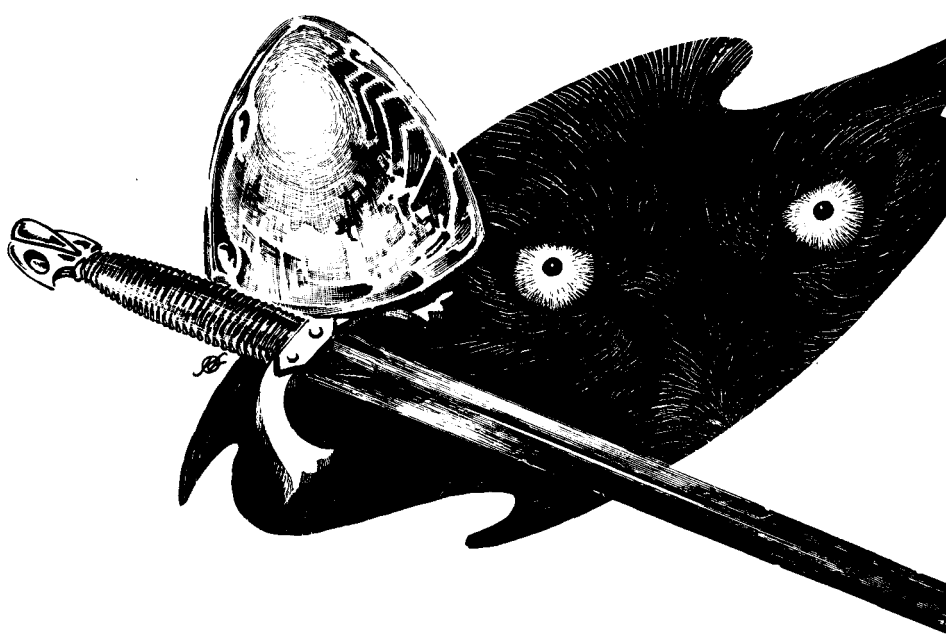
By the time the women started moving, the chief of the band was perhaps a kilometer ahead. Nils called to Ilse telepathically. She did not turn; her mind responded.

"Nils!"

"Are they going to attack Doppeltanne?"

She wrenched her mind to the question. "Yes. And be careful. He's a psi you know, and he understands a fair amount of Anglic. He began learning it from a Polish woman and I have taught him more." She began to ride slowly, letting most of the women pass, until one of the rear guard shouted at her and gestured with his lance.

"I'll try to get you free tonight," Nils thought after her.



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"Don't take chances. Perhaps I know how to kill him."

"Tonight," his thought followed her. "We'll make our move tonight if we can." He watched her out of sight. The information should be safe with her, he thought, if she'd been able to submerge and screen well enough to cook up a murder scheme without her captor reading it. One of Kazi's psi officers must have discovered the man's potential and had him trained, Nils realized, as Raadgiver had done with him. Operational telepaths didn't just happen.

Several tents remained. Two women worked around them, and two guards sat beside a fire, talking and laughing. A man came from one of the tents, helping himself with a crutch. Very carefully Nils moved back from his post toward the hiding place of his companions. Softly though he moved, his approach awakened Erik, whose hand moved quickly to his sword as he sat up. Leif grinned. "I let the growing boy sleep late," he said softly in his lilting Norwegian. "I thought I heard our friends leave, but by the way you moved they must have left some behind. Do we take them?"

"We'll get our horses first. They seem to be the walking wounded, with a pair of women to look after them and a couple of guards. The guards' horses are tethered at the camp. The women can ride them."

The northmen hiked over the ridgetop and down to their horses, saddled them and fastened the bits in their mouths, moving unhurriedly. Then they rode back and walked their horses slowly toward the camp.

When one of the guards heard their approach and looked up they kicked their mounts into a gallop, and cut them down while they scrambled for their bows. One of the women half choked a scream and then both stood by, frightened. These savage foreigners in deerskin breeches, with furs on their steel caps, seemed just a different variety of horse barbarian. While Erik sat with arrow on bowstring, covering, Leif and Nils rode around cutting the lodgepoles with their heavy swords and knocking down tents. As the occupants ducked, or crawled out, or lay humped beneath the hides, they were killed.

One stared as Nils charged at him, a shock of recognition on his dark scarred face. Nils turned aside at the last instant, his horse almost bowling the man over. A picture had flashed through the horse barbarian's mind, of this same giant warrior with straw-colored braids, standing naked and weaponless in an arena, a grinning orc officer stalking him, sword in hand. And himself, disgusted at the odds, standing and throwing his own curved sword down into the sand at the giant's feet.

"Let that one be!" Nils shouted,

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and left the man leaning on his crutches while they finished their killing.

The women trembled as Nils turned his horse and looked at them. "Can you ride?" he asked in Anglic.

They nodded dumbly.

"Then get on those horses. Ride to the top of that ridge and go in that direction." He pointed. "Do you unde stand?" They nodded again. "In a few hours you'll come to a road. Ride *down* the road. Not uphill, but *down*hill. When you come out of the forest you'll soon arrive at a crossroad. From there you'll see a castle. Go to the castle. Tell them that the enemy is attacking Doppeltanne. Doppeltanne! Now tell me what I said."

Hesitantly and with help they repeated his instructions, then walked to the horses and rode away, glancing back frequently until they were out of sight.

"Think they'll get lost?" Leif asked.

"Hard to tell. I wouldn't be surprised," Nils answered. Then he turned and looked at the man he'd spared.

The stocky barbarian still stood staring at them, not knowing what to expect. He didn't imagine that Nils knew who he was. He'd been one among tens of thousands shouting in the stands that day, and when he had thrown the sword the giant had had his back to him.

Nils dismounted and walked up to him. "You gave me a chance to live," he said. "Now we are even." The Swedish words meant nothing to the man, but the tone was not threatening. The other northmen looked at each other. Nils jabbed the man lightly on the shoulder with a thick sword-calloused forefinger, then pointed to the man's side, where his sword would have hung. Next he moved as if drawing a sword, and made a throwing movement. Pointing to himself he bent as if to take something from the ground, then held out his hand as if armed. The man stared with awed understanding.

Nils remounted then and they rode leisurely to the meadow where the horse barbarians had kept their horse herd. There the northmen hobbled their mounts and let them graze until after noon, while they napped in the warm sun.

It was night. The horse barbarians had loosed their horses in a field fenced on three sides with rails and on a fourth with a tight hedge. The fence wasn't high enough to keep horses like theirs from jumping over it, so they had hobbled them.

Their chief had posted four guards on horseback, to patrol outside the paddock, and they were disgusted to be pulling guard duty while they could hear the drunken shouts and occasional screaming from the village. So when buddies

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sneaked out to them with two flagons of schnapps, they didn't hesitate. Dismounting, they tethered their horses to the fence and squatted down together with their backs against it to test the contents. The chief, they agreed, would be too busy enjoying himself to check on them, or if he did, it was very dark and the moon wouldn't even rise until after midnight. They'd be able to hear him before he found them.

The three northmen lay in the tall grass at the edge of a ditch, listening to their slurred speech and quiet laughter.

He had read his peasants well, Hannes realized. The thirty he'd chosen, almost all of them youths, had more violence simmering in them than he'd realized they could generate. To strengthen their anger and help them lose their fear, he had purposely moved them close enough to hear the shouts and occasional screams from the distance. But not too close, for Nils had warned them that one of the horse barbarians was a psi. Probably their chief, Hannes decided. Now he listened to the thoughts and emotions of his men. Many were mad enough that they were not even nervous, only impatient. A few were managing to doze, but the night was too cold here behind the hedge to sleep soundly, and their homespun blankets weren't for out-of-doors.

He looked at the bulk of the northman beside him. Sten. The face was turned eastward. Occasional thought patterns in unintelligible Swedish drifted through the man's mind, with fragmentary and partially visualized scenes, but mostly the neoviking's mind was almost motionless, though awake, and quietly serene. To a degree it reminded Hannes of a cat they'd had at home when he was a boy. Or of Nils.

He turned at the thought of Nils, and looked past the village toward the black mass of low mountains that began a few kilometers west of it. Had the three northmen survived their scouting expedition? Had they found the paddock? If they hadn't—Shivering partly with cold and partly with nerves, he tried to shake off the morbid line of thinking. But thoughts of death came back to him. Would Sten feel grief if his three friends were killed? There was clearly a bond of affection between them. Yet somehow Hannes didn't think Sten would. It would be like his cat. She'd loved her kittens, in her way, and defended them, but when one of them was killed she'd sniffed it and then walked casually away without any sorrow that he could sense. Leif might feel sorrow, and Erik would feel rage, but Sten was somewhat like Nils.

Nils. Someday the big psi-warrior would die, and probably by

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the sword, but somehow he didn't believe he was dead now.

Zühtü Hakki lay on his side on the straw-filled tick, staring through the darkness at the dim form of the woman on the heap of hay across the room. She lay still but her mind was awake, her thoughts an inarticulate mental murmur in German. From somewhere outside he heard coarse laughter. Drunk, every mother's son of them probably. Even the paddock guards. All but Mustafa and his detail. *It's a good thing the enemy are all bottled up inside the castle,* he thought. *Old Mustafa will keep his boys sober and in the saddle. And the dogs in the castle won't try to sally out past that pack of wolves. Mustafa never drinks. The older men say he never did. Wonder why? Almost unheard of, a man who doesn't drink. Besides Mustafa I'm probably the only man here that's voluntarily sober, and I've had a pull or two. Funny that since my psi was trained I've had no desire to get drunk. Other desires, but not to get drunk.* He opened his eyes again and looked toward the woman. *There must be prettier women in this village,* he thought. *Plump ones. But I'll stick with this one. You can get tired of a pretty woman, but this one has a mind. Funny. Until my psi was trained I never cared if a woman had a mind. And tonight she was different. No wonder I'm tired. Very tired. Loose and relaxed and very very tired. And safe here. Safe and secure. My eyes are heavy. Very very heavy. They keep wanting to close. Can't keep them open any more. Now they're closed. And I can't open them. Couldn't open them if I tried. I don't want to try. Sleepy. I'm falling asleep. Falling deeply asleep. Deeply asleep. It feels so good to fall deeply deeply asleep.*

Ilse kept the thoughts running through her/his mind, surrounding them with full soft inner feelings and pictures of sinking through clouds. She took him deeper and deeper. *And now I can't move,* her mind murmured. *I don't want to move and I can't move. It's very peaceful here, and I refuse to move, or see, or hear, or feel.*

She continued this briefly. Then she rose quietly, rolled the comatose chieftain off the straw tick, and pulled his war harness from under it. And usually, she thought, he sleeps as lightly as a cat. The curved sword was not too heavy and her arms were strong. There was light enough from the dying fire. She kept her eyes on the neck and swung hard, then, with a shudder, threw the blade on the tick and wiped her hands on her greasy homespun skirt, although there was no blood on them. Her mind shifted outside where it found a drunken guard sleeping on the cold doorstone. Fumbling in

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the gloom she got the knife sheath off the harness and fastened it to the strip of homespun that served her as a belt.

Then she opened the shutters and climbed out. A peasant body lay under the window, where it had fallen off the roof during the brief afternoon battle, and she stumbled on it. A ladder still leaned against the thatched eaves. She climbed it and huddled grimly against the stone chimney.

A few men could be heard, or sensed, still wandering, or staggering, between the huts or down the village street. She heard the sound of violent vomiting, followed by roars of laughter. But most of them were inside now, out of the cold, sleeping. She could barely sense their sleeping minds through the log walls.

It wouldn't do to be up here when the sun rises, she thought. *If nothing happens by the time the moon is halfway to the meridian, I'll have to try to get away by myself.*

Two of the horse guards were asleep and the other two squatted murmuring and laughing. They were too dulled to hear the bowstrings. One slumped to his side. The other rose unsteadily to his knees, looking stupidly at the arrow in his belly, then fell forward.

When they finished, the northmen pulled down the top rails from a section of fence, throwing them out of the way. Then they mounted three of the guards' horses and rode them into the paddock. The animals there were conditioned to the smell of blood and sounds of death, and for a while they didn't take alarm as the warriors quietly walked their mounts around, casually killing horses with their swords. After a bit they spooked however, milling around in the darkness, and the northmen worked faster. Some found the gap that had been made in the fence, and Erik stationed himself there as guard, as well as executioner. It didn't take them too long to panic, crow-hopping and whinnying in the light of the half-risen moon.

The reddish moon, shaved to slightly less than half a disk, had risen almost entirely above the hills, throwing a pale light over the valley, and long black shadows. The sentry atop the gate tower strained his eyes northward. Something was going on over there with the enemy's horses, but it was much too far to see by moonlight. *The swine outside heard it, too,* he thought. One of them was shouting orders, and three trotted their horses down the road in that direction.

When the first limb of the moon had shown, he had hissed the news down to the courtyard and the knights had mounted their horses. The sounds of their low voices had stopped and they sat in grim silent

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readiness. All he could hear now was the occasional impatient sound of a hoof stamping on the packed ground, or a creak of leather.

Suddenly there was another sound, startling him, distant shouts and whoops, as of horsemen riding into the village from the east. The enemy outside turned, staring in that direction but unable to see a thing except the buildings standing dimly in the moonlight across the fields. Their captain trotted his horse a few tentative steps in that direction, stopped for a brief moment, then shouted a command. The whole body of them broke into a gallop toward the village.

The sentry called down quietly and heard the dull sound of well-greased chains as the portcullis was raised. The gates opened and the knights trotted out, then spurred their horses forward.

Sten led the peasant charge, and just outside the village his war whoop signaled theirs to begin. Briefly they roiled through the village, chopping at the occasional enemy caught outside, before those inside roused and began to stumble out of doorways. Sten knew there was nothing like danger to clear the fumes from a drunken brain, but still, the enemy was afoot, confused, and slow of reflexes, and the clumsy hate-filled peasants rode hewing among the huts.

Then, more quickly than he'd expected, the angry sober troop that had stood watch outside the castle were on them, and he shouted, and heard Hannes shout, to ride, ride out of the village. Peasant blood-lust turned to panic before the onslaught, and they rode, or tried to, streaming out into the field, with clots of raging horse barbarians cutting them out of their saddles. Wishing he were the horseman the enemy were, Sten drew alongside Hannes, guarding him because he knew the man was something to Nils.

The knights had bypassed the village to the east. There were only twelve of them but they were strong and battle-hardened and they hit as a solid wave, unexpectedly, rolling up the flank of the already occupied enemy. The remaining peasants rode on in unmolested horror as their pursuers turned to face the assault. Slowly, as the horse barbarians rallied, the knights began to give back toward the castle.

And from a roof a huddled half-frozen girl cried out with her mind, "Nils, Nils, come and get me!"

This gray dawn was the coldest yet, and the horses' hooves sounded sharply on the frozen ground. There were no clouds. To the east the sky shone yellow along the line of hills as they rode southward down the road. Ilse was draped with a sleeping robe dropped at a door by a horse bar-

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barian and snatched up by Nils as the three warriors had galloped through the village to get her. Sten had just caught up with them, having circled eastward.

Hannes, he said, had stayed with his men, leading them into the forest.

"And what will happen to them?" Ilse asked. "Will the enemy hunt them down?"

Nils smiled. "The first thing the enemy will do is see what horses he can find. And it won't be many. Mostly peasant plow horses." He turned to Sten. "How many horse barbarians died, do you think?"

Sten answered in Swedish so that Erik and Leif could understand. "I'd guess maybe twenty were killed this afternoon with bows from the roofs, but that's just a guess. I watched it from a hedgerow, but not very close. And tonight Hannes's peasants must have tallied twenty or more killed—killed or maimed, that is. Their strokes weren't too accurate and I kept worrying they'd fall off their horses. The knights killed ten or a dozen in a hurry when they hit, and probably a few more getting back to the castle. And the archers at the castle might have got lucky in the moonlight and knocked off a few if they followed the knights too close to the walls. How many does that come to?"

"Maybe sixty," Nils answered. "And we killed four paddock guards and maybe half a dozen in the village when we rode in to get Ilse. And we killed horses until my sword arm got so tired I had to switch hands."

He turned to Ilse. "We were talking it over so that Leif and Erik could understand. We'll have to teach you Swedish now. Our people don't know Anglic."

"Perhaps we should teach Leif and Erik Anglic, too." She smiled when she said it, but Nils sensed something behind the words and thought questioningly toward her. "I had a precognition weeks ago," she said. "Men will come out of the sky in a starship, men like the ancients, speaking Anglic. And they will fight your people." ■

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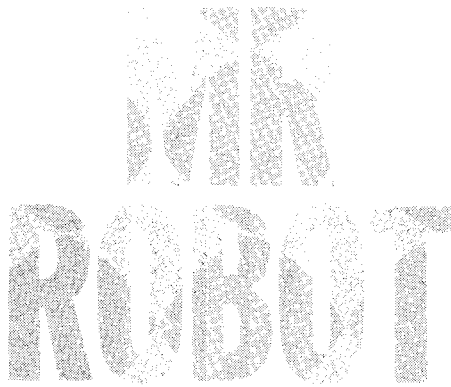

LOUIS L. SUTRO
and
WILLIAM L. KILMER

Revised from the article:
"Assembly of Computers to Command and Control a Robot"
from AFIPS Conference Proceedings.

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The robot is old in science fiction; it's easy to talk about them so the writers can always be ahead of the men who try to make one. For one thing, who needs a true robot, a versatile, multi-function machine of immense sophistication, when men are available?

On Mars, men are not available—and won't be until after a lot of preliminary testing has been done. Surveyor did fine on the Moon, scratching its trench with a digger controlled from Earth. Even hopping up and moving a few feet on command.

But Mars will be half an hour away, as radio photons fly, for round trip Earth-based control. We have to have a self-controlling, seeing, judicious robot to explore for us first!

And at the MIT Instrumentation Laboratory, Sutro and Kilmer have been developing MR Robot—the Mars Rover robot.

This is, literally, a how-to-do-it account of building a robot that can not merely transmit pictures, but can look and understand what it sees!

Louis Sutro is Assistant Director of the MIT Instrumentation Laboratory; William Kilmer is Associate Professor of Electrical and System Science at Michigan State University.

Because the article, with essential illustrations, is so long, we have been forced to omit the extensive appendixes and bibliography that accompanied the original Report. THE EDITOR.

1. INTRODUCTION

There is a growing consensus among predictors of science that the world is about to witness the evolution of what might be called a new species —the robot. Whereas, animal evolution was a trial-and-error process, robot evolution appears likely to be carefully contrived. Starting where animal evolution left off, that is, with man, robot evolution promises to excel man in some respects, and be excelled by him in others.

To the computer profession, one challenge in this progression is to develop computers for robots that match those that have been found indispensable in men. We are aided in this task by the description of the human nervous system in computer terms by physiologists such as Warren McCulloch.

With his description before us, we have devised working models of two of the five principal computational domains which he identifies in the nervous system of vertebrates, including man. Others are devising working models of other domains. Implemented in light, portable hardware and connected together, these computers promise to provide intelligence for a system that will sense its environment, move about and

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perform useful tasks.

Who needs a robot? Everyone who would like help with tiring chores. However, early models with large arms and wide wheelbases cannot move around the home or office. One need that has led to the development about to be described is exploration of the planet Mars. For this task, robot development is being pursued, not as an end in itself, but as a framework within which to develop an automatic visual subsystem. A second need is for a computer to command a system receiving several forms of input, such as sight, sound, touch, and reports on its own movements. Here again robot development provides the framework for the computer development.

As well as can be determined, the surface of Mars is open country where a wide-wheelbase vehicle should be at home. More to the point, the only exploration there for a decade or more will have to be either by a remote-controlled or an automatic vehicle. The distance is such that a single bit of information requires 15 minutes, on the average, for transmission from Mars to Earth. With such a transmission delay, remote control seems hardly practical. An automatic vehicle, or robot, thus seems imperative.

While the surface of Mars is colder than the surface of the Earth, there may be hot spots due to volcanic or other sub-surface activity. All the moisture on Mars, according to our instruments, is in the form of either gas or ice. The atmospheric pressure is too low to hold it as water, but it might pass through the water phase in these hot spots, lasting as water long enough to make possible life as we know it.

To go to these hot spots, if indeed they exist, poke around them, pick up and examine samples seems the best way of finding out what is there. Even if there is no life on Mars, there are cliffs formed at the edges of craters, that need to be examined for their geology. The craters need to be climbed into and out of. To go from one crater to another, crossing must be made of the ravines called "canals."

2. RESEARCH AND DEVELOPMENT

The robot design described here began as an effort to design eyes for the artificial intelligence that Marvin Minsky and John McCarthy called our attention to, in the fall of 1958. Persuaded that eyes for artificial intelligence could be achieved only by employing ideas from animal vision, one of us (Sutro) approached Dr. McCulloch for advice. The collaboration that ensued led first to an analytical model of an animal retina that

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recognizes objects, namely, the retina of a frog. It led next to a proposal to NASA to develop means of reducing, for transmission to Earth, pictorial data acquired in the search for evidence of both life and geological changes on Mars. Supported then by the NASA Bioscience Programs, we undertook this in the manner Dr. McCulloch and we thought best, namely, to model animal vision in lightweight, low-power hardware. Study of frog vision showed how recognition of a simple shape—a bug—can be achieved in two levels of computation, but it did not carry far enough the data reduction we felt was required. Needed, we felt, was reduction of a stereo pair of images on Mars to a pair of line drawings with shading, as we primates do. Geologists and biologists make line drawings with shading to represent what they see. The lines portray edges, angles and silhouettes. The shading conveys the brightness of surfaces.

Man forms in his head a model of what he observes. Formation of a line drawing with shadings is a stage in the computation of this model. However, as Dr. McCulloch points out, the vision of a primate cannot be modeled by itself. Data flows not only inward from the images, but outward from the brain to adjust the filters, focus, convergence and direction of gaze that select what will flow inward. For a visual system employed in a single position on Mars, these adjustments can be either preset or changed by commands from Earth; but when the system is required to move about, the commands to adjust it can scarcely be sent from Earth. They have to be generated on site.

To develop a command computer one of us–Kilmer—undertook to model the part of the vertebrate brain that decides from information received through all the senses what class of thing the animal will do from moment to moment. This is the core of the animal's reticular formation, extending through its brain stem and the length of its spinal cord. Support for its development came first and continues from the Air Force Office of Scientific Research, came then from NASA's Electronic Research Center, and comes now from the U. S. Air Force bionics programs.

Cameras and computers under development are pictured in Fig. 1. At the left is a binocular pair of TV cameras of which sufficient study has been made to indicate that each camera can be built to view the world through both wide- and narrow-angle lenses. Receiving the output of the camera is the visual first-stage computer which enhances contrast in an image, as an animal retina does. Next to it are switching filtering and comparison structures, we call the visual second-stage computers. A model of the environment consists of relations formed in this second-stage visual computer and stored in the visual part of the relational

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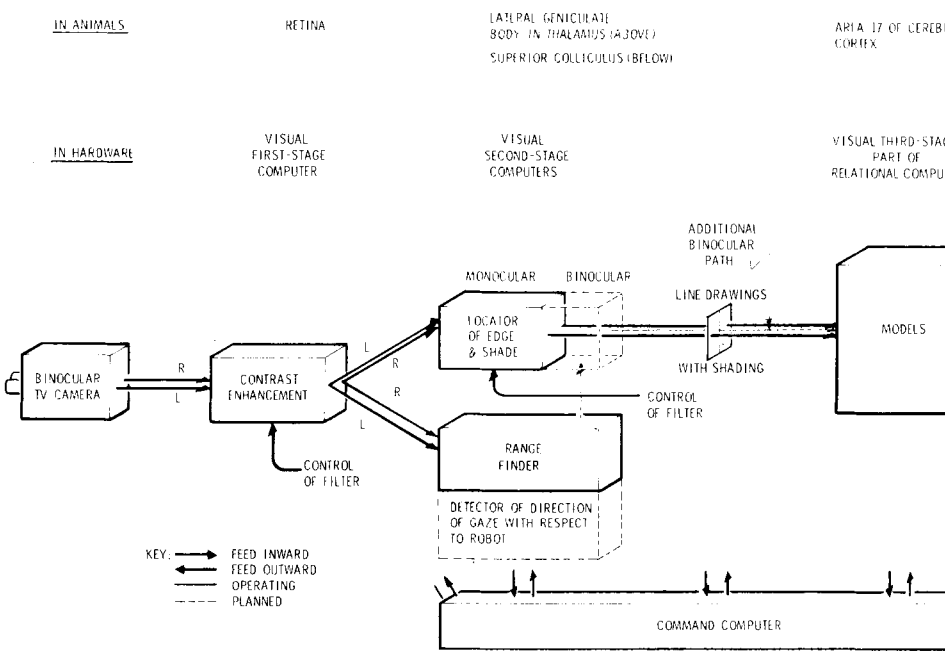

FIG. 1

computer. A line, which indicates sharp change in luminance, is a relation of high spatial frequencies. Shading, which indicates the difference in luminance of areas, is a relation of low spatial frequencies. Each filter passes one band of frequencies more than others. Commands to adjust filters, focus and direction of gaze are shown as arrows rising from the command computer in Fig. 1. Since these commands will pass through structures not shown, the arrows are not drawn directly to the cameras and visual computers.

Note the dashed boxes. The present locator of edges and shades, represented by a solid box, forms a stereo pair of monocular line drawings. The dashed box marked "binocular" represents computation now operating separately to determine that pairs of points in the left and right views are "homologous," that is, representative of the same point in three-dimensional space. Binocular, or range-finding, computation will be merged with the locator of edges and shades.

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At first, we called a vehicle designed to carry this system "rover." As we came to conceive of it with other senses, besides vision, and other effectors, beside wheels, we renamed it "robot."

3. BIOLOGICAL COMPUTERS

From his life-long study of the human nervous system, Dr. Warren McCulloch has concluded that the essential features of its computations provide a good basis for the design of a robot. Although as a neurologist, psychologist and physiologist, he is aware of the difficulties involved in embodying mental functions in physical devices, he has nevertheless developed a simplified model of a vertebrate brain. His intention is merely to suggest an organizational structure necessary for efficient robot performance.

Figure 2 outlines his model of the vertebrate nervous system, identify-

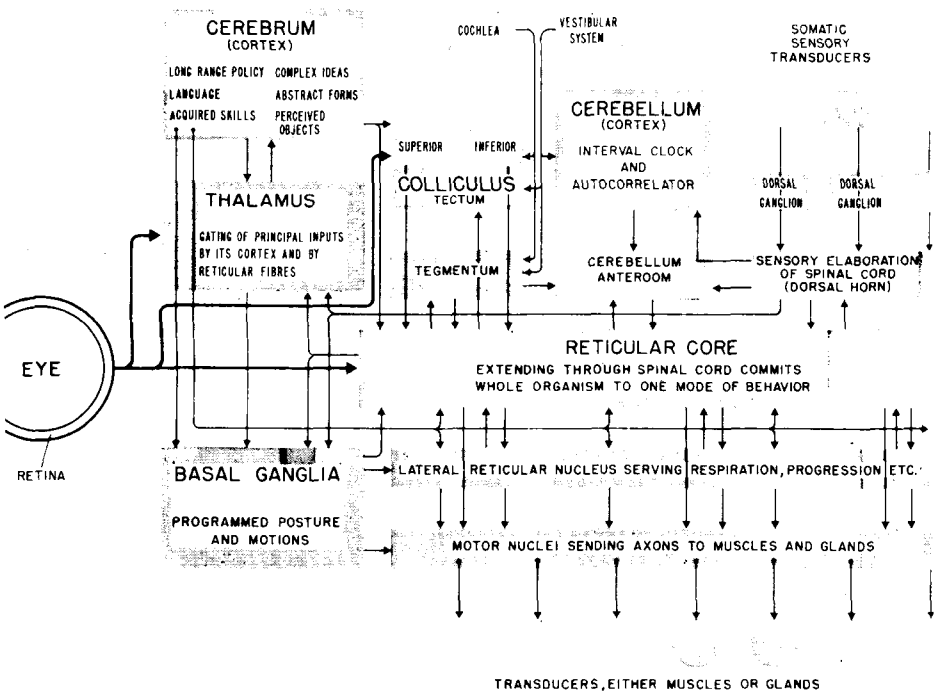

FIG. 2

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ing what he feels are five principal computational domains and their chief functional connections. At the left is the *retina,* consisting of three layers of cells, two of which seem to perform most of the computation. The eye is shown as representative of the senses because its computational capacity qualifies it as a principal computer; it is the foremost data source to the primate brain, providing two million of its three million inputs. Other senses shown are acoustic—represented by the cochlea—vestibular and somatic.

At the upper left is the *cerebrum,* which Dr. McCulloch calls the "great computer" and in which computation is carried out in many layers. Each of these, if unfolded from our brains, would be about the size of a large newspaper.

The computer which controls all others is shown at the center right. It is the *reticular core* of the central nervous system which extends from the base of the cerebrum through the spinal cord. It directs the main focus of attention so as to determine what type of activity is to occur from moment to moment. By committing the animal to one or another mode of behavior, it controls all other computers and, through them, the whole organism.

Clusters of nerve cells at the base of the cerebrum comprise the *basal ganglia,* a computer shown at the lower left of the figure. Here are programmed all of the innate or learned total action patterns of the body, such as feeding, walking or throwing a ball. Additional programs are acquired through the growth of connections to the motor-control nerve cells, shown along the bottom of the illustration.

Completing the list of principal computational areas is the *cerebellum,* shown at the top of Fig. 2. It computes the termination of a movement, such as reaching to touch an object, and requires inputs from the vestibular system, to detect tilt and acceleration of the head, and from skin- and muscle-sense cells to detect posture and the nature and position of what is being touched.

Interconnected with the principal computers are switching structures, such as the thalamus, colliculus, and cerebellar anteroom. In fish, amphibians, and birds, the superior colliculus perceives form and movement; in visual mammals, it determines the direction of gaze and reports by thalamic relay the cues of seen motion to the secondary visual cortex. The inferior colliculus is concerned with auditory and vestibular inputs as well as with orientation of the body image in space. Below the colliculus is the tegmentum, which is concerned with the relations between things seen, heard, and felt and the control of progression and postural righting actions.

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Around the reticular core are specialized structures that could also be called computers, such as the nucleus of nerve cells that control respiration and other routine bodily functions, and the dorsal horn of the spinal cord, through which pass inputs from sensory cells. Note that the reticular core acts on all other computers and that they report to it. It reaches decisions with the aid of raw data from the sensory systems but its main input comes from the other computers.

The computers of Fig. 2 are shown as they are arranged in animals with horizontal spines. Monkeys and man have the same computers in approximately the same relation, but the arrangement is vertically distorted, with the cerebrum, now very much larger, at the top.

All these computers have a common ancestry. All evolved from the central computer, the reticular core, and in so doing have established only those interconnections necessary for efficient communication with it. Out of the reticular core has thus evolved the complexity necessary to meet the demands of the entire system.

4. AN ENGINEERING ANALOG

Figure 3 is a diagram analogous to Fig. 2, labelled with engineering terms to suggest how the animal system can be simulated. For example, in place of the retinas are the cameras and the visual first-stage computer, previously shown in Fig. 1. First stage computers receive inputs from all of the senses—auditory, vestibular and somatic sensory. Each is called a computer rather than a precomputer or preprocessor to indicate that it receives feed-outward signals from the central computers.

Other substitutions are as follows:

command computer	for	reticular core
relational computer	for	cerebral cortex
timing, coordinating and autocorrelating computer	for	cerebellum
computer of effector sequences	for	basal ganglia (nucleii)
executive computer	for	lateral reticular nucleii

The connections to the command computer shown in Fig. 3 are only those referred to in this paper. Eventually this computer will connect to every subsystem and every subsystem will connect to it. Examples of sensory subsystems are visual, auditory, vestibular, contact and kinesthetic. Examples of effector subsystems are vehicle, arms, camera focus and camera gimbals.

When the feed-outward paths are added, and control loops are drawn

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through the environment in the manner spoken of in Section 2, the system is seen to be composed entirely of closed loops.

5. LOGIC IN BIOLOGICAL AND ELECTRONIC COMPUTERS

On the one hand, we have the nets of the nervous system; on the other, the contrived logic of electronic computers. In a living nerve net, branches interconnect; information from every source mixes at many places with information from every other source, and affects every output. This is called an "anastomotic net."

The electronic computers we are designing at present are not programmable general purpose (GP) machines. A GP computer is primarily intended for sequential computation on stored data. It is adept at taking data from one part of memory, modifying it, then putting it back into memory. The need here, however, is to compute on a large-volume stream of data entering from the outside. Accordingly, special purpose (SP) computers are being designed in which computation is performed on the data soon after it enters the system from one or many sources. There is

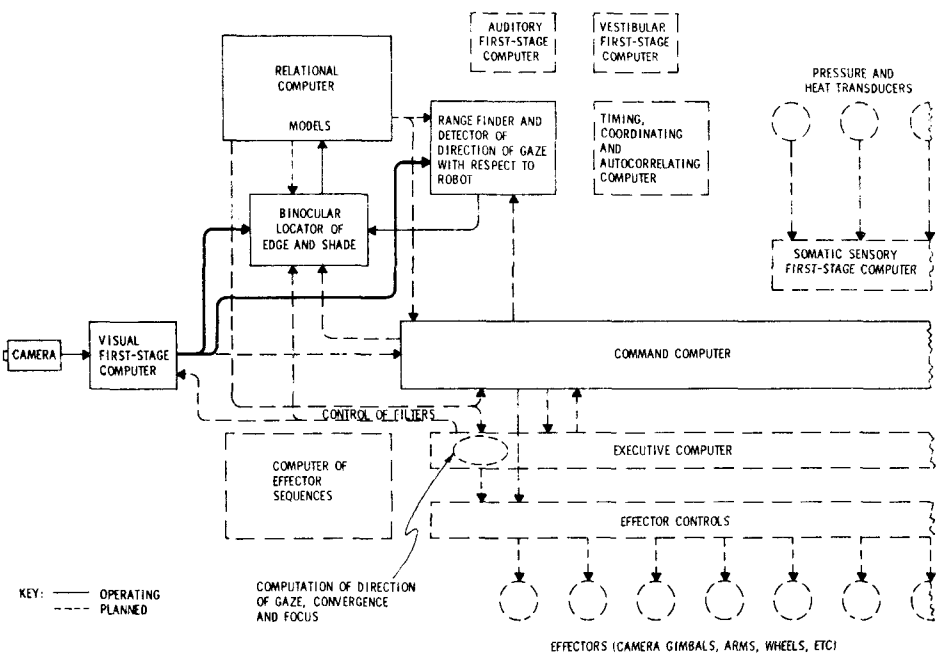

FIG. 3

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no more than buffer storage between the entrance and the computation.

For each of the "five principal computational domains" described in Section 3, we aim to build an electronic approximation to an anastomotic net. To do this we need to:

1. Approximate its functions;
2. simulate these approximate functions in a configuration that is realizable in hardware and
3. realize these approximate functions in an SP computer.

For example, to design a model of a retina we first approximated its function of enhancing contrast by the function described in Section 7. We call this function a "visual first-stage computer," are simulating it in a GP computer, and have partially constructed an SP computer to do it. Other functions of the retina will also be simulated such as enhancement of color contrast.

To design a command computer we first approximated the function of the reticular formation in animals, described in Section 13. We call the successive simulations S-RETIC and STC-RETIC. Design of an SP computer to perform these functions is under way.

6. MEMORY

What characterizes the evolution of S-RETIC into STC-RETIC is the addition of delays which provide the storage that is basic to memory. The same will happen in the evolution of the visual computers. They now include no memory, except for shift registers required for computations, because, for early Mars landings, the intent is only to reduce pictorial data on Mars for reconstruction and viewing on Earth. STC-RETIC, on the other hand, can be conditioned to respond to a pattern of stimuli, can drop out this conditioning in the process called habituation, yet can pick it up again. These traces are stored in tables in STC-RETIC, but will be stored in adaptive elements in the hardware design. What are stored are the modes of behavior that are responses to general stimulus patterns.

Visual memory will store the relations found in these stimulus patterns by the visual subsystem. Hence the term: relational computer. An object will be stored, not as a picture, but as a structure of relations, or model, which cause the robot to do something: run from the object, pick it up, experiment with it. Such a model can either be built in or learned.

If we construct a robot, it will be primarily to perform a useful task, and only secondarily to show what is in its head. Aptitude for drawing

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pictures can be built in and proficiency learned. Since the camera-computer chain proposed for an early Mars landing is only part of a robot, its only useful output will be stereo pairs of line drawings with shading. If it evolves into the visual subsystem of a robot, the relations it now forms into line drawings can be in a three-space memory where they can be rotated so that they can be viewed from any direction.

We would call this memory an "associative" computer were it not that this term has a different meaning in engineering than in physiology. In engineering, it means, "content addressable," which is not an adequate memory from our point of view. As Dr. McCulloch puts it, "The memory we need should be addressed on the basis of relations, appropriate to its mode of behavior. We know *a priori* that spatial relations, constituting objects, form categories both to guide locomotion, et cetera, and to form the bases of descriptions. Size and precise shape are secondary. Just as a baby has a built-in mechanism to find and follow faces, and only later to recognize particular ones, so our robot should see abstractions first and qualify them later in terms of corners, angles, surfaces and edges, as we do a face, in terms of eyes, nose, mouth and eventually ears.

"Since a relation can be described in a sentence, a computer, designed with relational addressing for visual relations, can be extended to verbal ones."

7. FIRST STAGE OF VISUAL COMPUTATION

The scene before an animal eye or a television camera can be described as a mosaic of luminances. If you doubt this, take a luminance meter, such as a photographic exposure meter, and aim it in a sequence of directions from left to right along a horizontal line; then in the same sequence of directions along a second horizontal line, below the first, then along a third and a fourth horizontal line; and so on until you have scanned a square pattern or raster. The readings of the meter are the mosaic of luminances. Inverted and exchanged left for right, this same mosaic is the image at the back of your eye or on the face of a television camera tube.

As you observe point to point across the image, you can detect change in luminance and represent each change by a dot. Sufficient dots form a line and sufficient lines a line drawing. Addition of low resolution—low spatial frequency—changes in luminance gives the drawing shading.

Whether we take animal vision as our model, as we are doing here, or develop designs independent of the animal, as others do, we find that three stages of computation are needed to achieve the abstraction which

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we call a "line drawing with shading" and make it useful in the command and control of a robot. As shown in Fig. 4, the first stage enhances contrast. The second stage forms line drawings which are either mapped in the third stage or, as proposed for an early Mars landing, transmitted to Earth. A part of the second stage not yet tied into the sequence of Fig. 4, determines the range of dots mapped in the third stage. Still another part, to determine shading in the line drawing, has been simulated by an artist and will be automated and tied in later.

The stages presently operating as a sequence are broken down into levels in Fig. 4. Continuous luminance measurements made by the TV camera are sampled, converted to 6-bit digital words, and, in level 1, mapped. At level 2, parallel computation is performed on a number of luminance measurements which, for illustration purposes, is shown as 3 x 3, although in present experiments, it is 9 x 9.

The Jet Propulsion Laboratory (JPL) of the California Institute of Technology has improved, by computer, the quality of pictures sent back from the Moon and Mars and X-ray radiographs of medical cases. Their objective is "to make selected features easier to see. This might require suppression of useless data such as random noise and background shading or perhaps amplification of fine detail."

Our first objective on the other hand, is to reduce pictorial data for

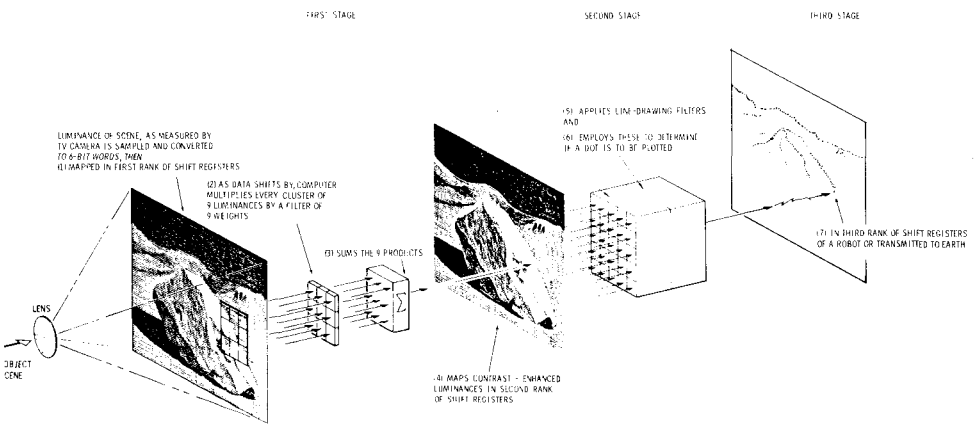
FIRST STAGE
SECOND STAGE
THIRD STAGE
LUMINANCE OF SCENE, AS MEASURED BY TV CAMERA IS SAMPLED AND CONVERTED TO 6-BIT WORDS, THEN
(1) MAPPED IN FIRST RANK OF SHIFT REGISTERS
(2) AS DATA SHIFTS BY, COMPUTER MULTIPLIES EVERY CLUSTER OF 9 LUMINANCES BY A FILTER OF 9 WEIGHTS
(3) SUMS THE 9 PRODUCTS
(4) MAPS CONTRAST - ENHANCED LUMINANCES IN SECOND RANK OF SHIFT REGISTERS
(5) APPLIES LINE-DRAWING FILTERS AND
(6) EMPLOYS THESE TO DETERMINE IF A DOT IS TO BE PLOTTED
(7) IN THIRD RANK OF SHIFT REGISTERS OF A ROBOT OR TRANSMITTED TO EARTH
LENS
OBJECT SCENE

FIG. 4. *Levels of visual computation performed on a mosaic of luminances. At levels 1 and 4, horizontal lines in the image represent bands of luminances; thus, the squares drawn on the image are oversize. The images are neither inverted nor turned right for left as they should be.*

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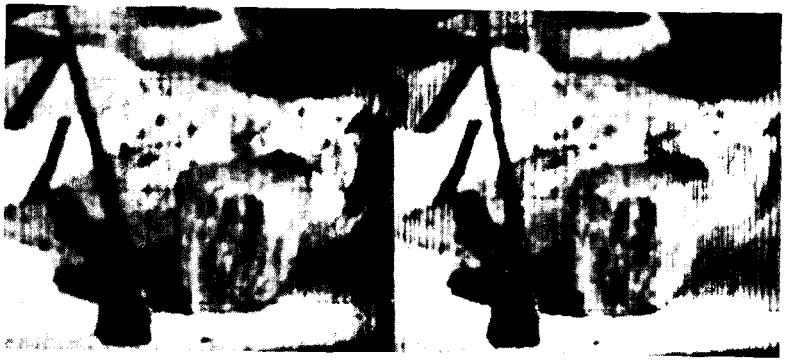

FIG. 5

FIG. 6a

FIG. 6b

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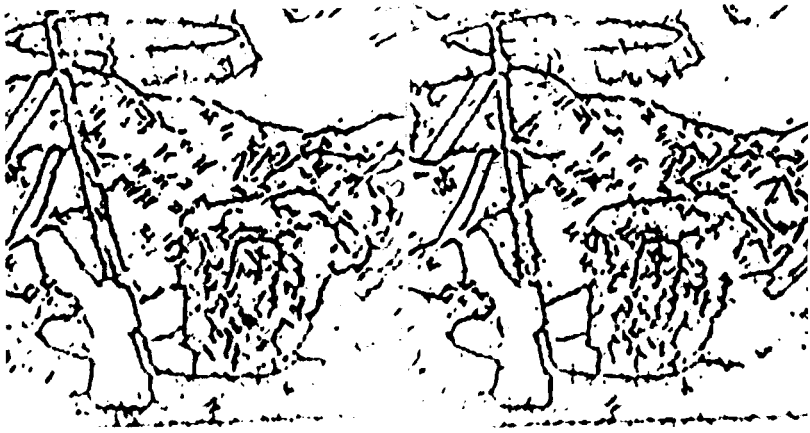

FIG. 7. *Line drawings formed from images of Fig. 6a.*

both transmission from Mars to Earth and for reconstruction there. Only after it has gone through reduction and transmission do we want to make it easier to see. Our second objective is to reduce pictorial data to enable a robot to see. Yet our objectives and JPL's appear achievable in the same way, namely, by operations on the spatial frequencies in the image.

The output of a TV camera is a waveform and as such is analyzable into frequencies of luminance amplitude in the horizontal direction of sweep of the camera beam. Since the TV raster is made of many lines, measured vertically, the image on the face of the camera tube is also analyzable in the vertical direction. The frequencies of luminance amplitude in all possible directions within the plane of the image are called "spatial frequencies."

Our equipment operates on these frequencies and amplitudes by employing digital filters, although the filters can be "analog" in the sense that computer designers use this term. A digital filter is a matrix of weights which can be made to operate on a matrix of luminances —the image—in the following way: Separate the matrix of luminances into small overlapping arrays called sub-matrices, convolve each sub-matrix with the filter and then sum. We will explain "convolve" as we do it.

To amplify fine detail, a filter should pass high spatial frequencies, reject low spatial frequencies and noise, and do this in all possible directions in the plane of the image. Eq. 1 shows a simple filter designed for this purpose, convolved with a sub-matrix of uniform luminances.

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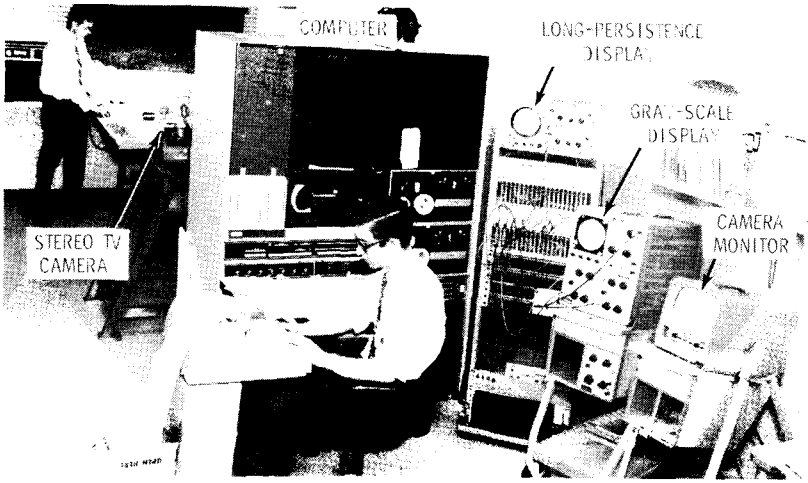

FIG. 8a

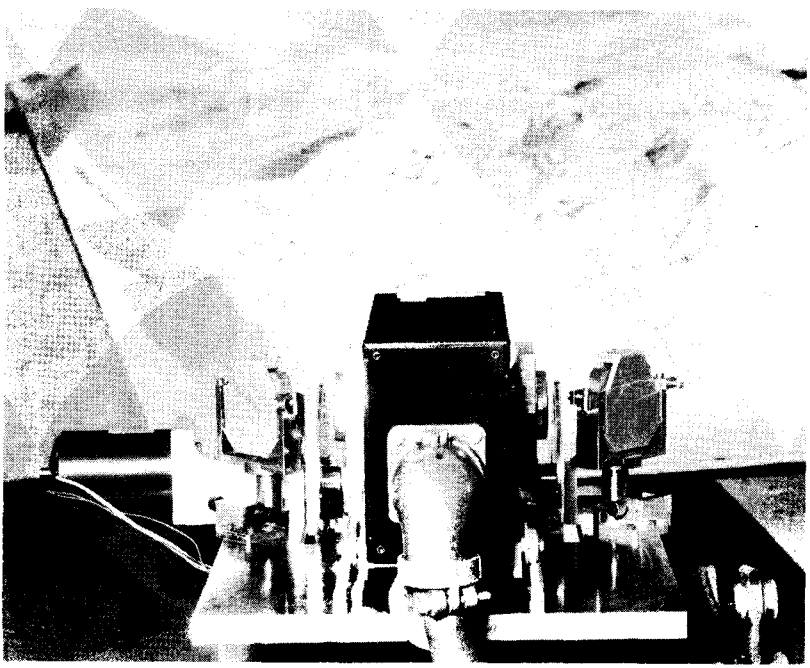

FIG. 8b

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(1)

1	1	1		−1	−1	−1	
1	1	1	★	−1	8	−1	= 0
1	1	1		−1	−1	−1	
Luminances				*Filter* W_1			

To convolve, as the star requires, multiply each number in the filter by its corresponding number in the sub-matrix of luminances and sum the product. Since this convolution sum is zero, adding it to the central luminance* in the sub-matrix of luminances produces no effect. That is, there is no fine detail. Given a sub-matrix of different luminances and the same filter, the convolution produces:

**"Luminance" from now on is used to represent luminance measurement.*

(2)

1	2	2		−1	−1	−1	
1	2	2	★	−1	8	−1	= 3
1	2	2		−1	−1	−1	
Luminances				*Filter* W_1			

Adding this 3 to the central luminance, in this case, 2, would enhance the contrast between the central luminance and the 1 at its left.

By extending the band of 1's in the above sub-matrix of luminances, indefinitely up and down and to the left, and the band of 2's indefinitely up and down and to the right, we obtain a full matrix of luminances. The dots represent numbers continuing outward:

		.	.	.	.	.		
		.	.	.	.	.		
.	.	1	1	2	2	2	.	.
.	.	1	1	2	2	2	.	.
.	.	1	1	2	2	2	.	.
.	.	1	1	2	2	2	.	.
.	.	1	1	2	2	2	.	.
		.	.	.	.	.		
		.	.	.	.	.		

If we convolve the filter W_1 with all of the possible overlapping 3 x 3 sub-matrices in this matrix and then sum, we obtain the following matrix:

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		.	.	.	.	.		
		.	.	.	.	.		
.	.	0	−3	3	0	0	.	.
.	.	0	−3	3	0	0	.	.
.	.	0	−3	3	0	0	.	.
.	.	0	−3	3	0	0	.	.
.	.	0	−3	3	0	0	.	.
		.	.	.	.	.		
		.	.	.	.	.		

Adding this to the full matrix of luminances we obtain:

		.	.	.	.	.		
		.	.	.	.	.		
.	.	1	−2	5	2	2	.	.
.	.	1	−2	5	2	2	.	.
.	.	1	−2	5	2	2	.	.
.	.	1	−2	5	2	2	.	.
.	.	1	−2	5	2	2	.	.
		.	.	.	.	.		
		.	.	.	.	.		

Thus where contrast exists, the high luminance has been made higher, the low lower. Both of the above methods of amplification or enhancement are called "lateral inhibition" because, while the center of the matrix is excitatory, the periphery is inhibitory. The bands of enhanced light and dark that result from application of the filter are called Mach bands after Ernst Mach who first described them. Our retinas perform this operation so that we see Mach bands wherever there is a steep step in luminance.

The multiplications in the above operations are pictured in Fig. 4 as taking place in level 2, the summation in level 3. To combine the two levels of computations we can double the central weight in W_1. Furthermore, to keep most convolution sums in scale we can multiply the filter by 1/8. The new filter can be described as such that the central weight equals twice the absolute value of the surround and the sum is one:

$$W_2 = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 16 & -1 \\ -1 & -1 & -1 \end{bmatrix} \times 1/8 = \begin{bmatrix} -1/8 & -1/8 & -1/8 \\ -1/8 & 2 & -1/8 \\ -1/8 & -1/8 & -1/8 \end{bmatrix} = 1 \quad (3)$$

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FIG. 9

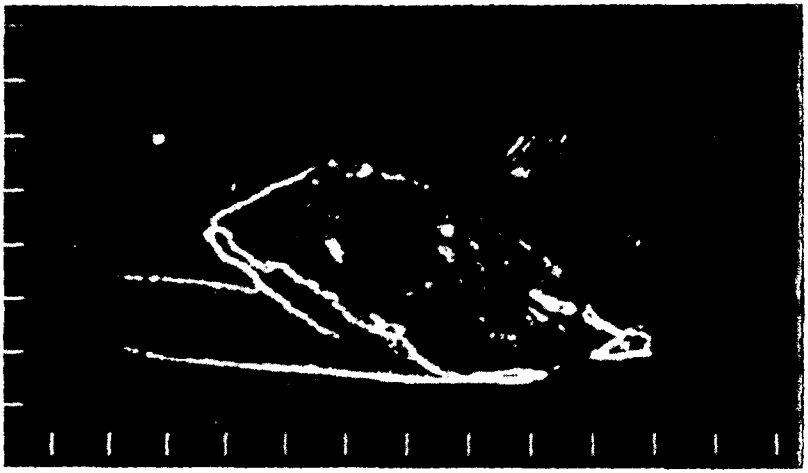

FIG. 10

By extending the above reasoning to include consideration of noise, Jerome Lerman devised a 9 x 9 filter which the computer then employed to produce the enhancement in contrast shown in Fig. 6a.* While this

*A stereoscope for reviewing this illustration may be obtained from Air Photo Supply, Yonkers, N. Y. Adjust it to your interocular distance. If you do not know this distance, use 63 mm.

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figure does not show the enhancement as clearly as the original read from the computer, the improvement can be seen along the right side of the rock and around the base of the hill at the left. Where there is contrast between adjoining luminances in the original image, enhancement makes the dark side of an edge darker and the light side lighter, thus forming Mach bands along the edges of the rock, the stick, the hills and the crater. Figure 6b shows the effect of enhancing the contrast of Fig. 6a.

The vertical lines in the displays of Figs. 5 and 6 are due to the method by which the computer of Fig. 8 acquires pictorial data. As the electron beam of the camera scans each horizontal line of the raster, the computer commands the reading of one luminance measurement. The computer employs the same command as long as it can with the result that successive measurements are below each other on vertical lines. The unevenness in the spacing of vertical lines is due to drift of one vertical line with respect to another in the display scope.

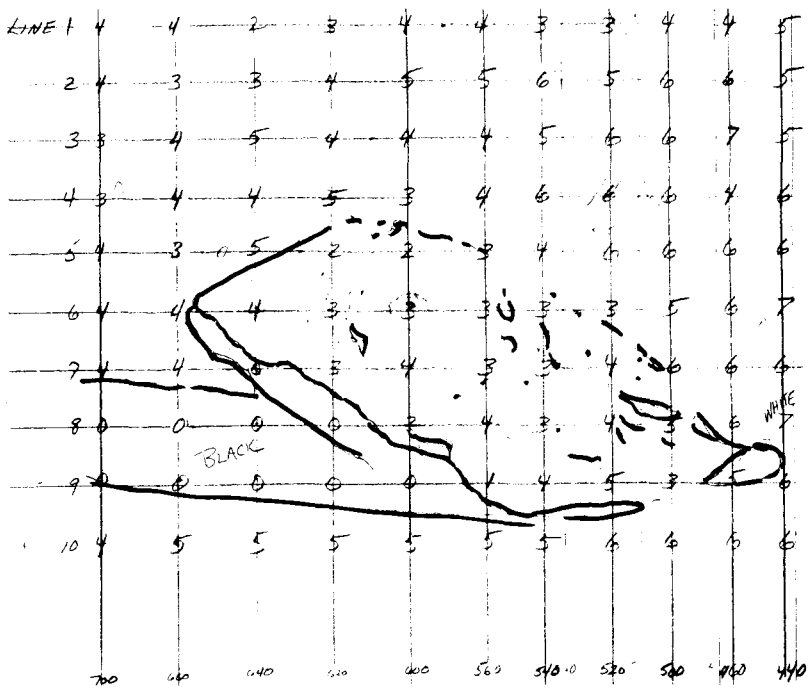

FIG. 11

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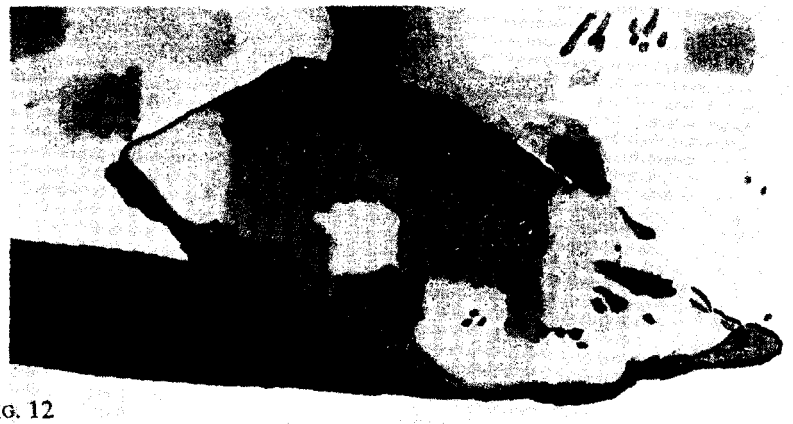

FIG. 12

8. SECOND STAGE OF VISUAL COMPUTATION

The second stage is being designed initially to reduce the contrast-enhanced image of a scene to a line drawing with shading, and later to permit perception and recognition. For the latter two purposes, filters can be adjusted, as the image moved past them, to seek a match with features in a stored model.

Thus, feature detection can be varied, not only for the entire image, but for each matrix within the image, under control of either a remote human operator or a local command computer. This position-by-position control of the processing of the image, represented by the leftward arrows in Fig. 1, separates our work from that at JPL. It makes perception possible.

Filters, to be described in a later report, extracted from the data of Fig. 6a the line drawing of Fig. 7. This line drawing does not contain enough information either for a scientist on Earth to judge what is being pictured or for adequate automatic comparison between incoming and stored data in the process of perception. However, by the addition of low-resolution luminance data to left and right views, and presentation of the two views stereoscopically, there may be enough information. Figure 10 is an example of levels 5 and 6 computation alone on data received from the scene pictured in Fig. 9. Figure 11 shows coarse-resolution measurements of luminance on a scale from 0 to 7, which an artist employed to paint in the swatches of gray in Fig. 12. When this reconstruction is performed by computer, it will illustrate how the appearance of a Martian scene can be reduced for transmission from Mars

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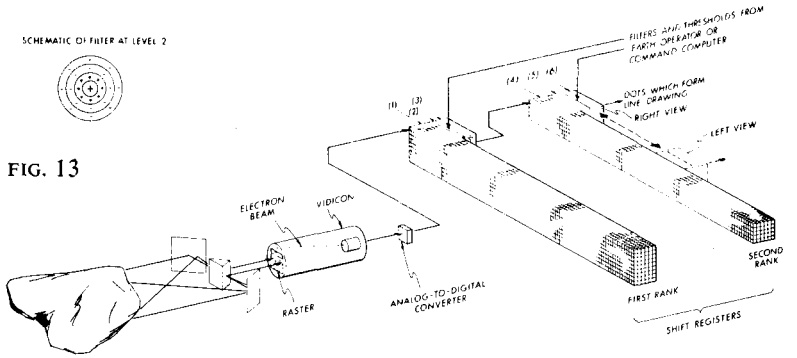

FIG. 13

to Earth and then reconstructed on Earth for viewing there. The data reduction here is by a factor of 30.

The stereo pair of views shown in Fig. 5 was not taken with the mirrors illustrated in Fig. 7, but by taking one view at a time and moving the camera between takes. This is simpler for a report.

9. HARDWARE VERSION OF VISUAL FIRST-STAGE COMPUTER

We designed the computation first so that it could be implemented in light portable hardware: then we simulated this hardware in the computer of Fig. 8 and achieved the results described above. The hardware design, diagrammed in Fig. 13, is inspired by the layered structure of the animal retina and laterial geniculate body of the thalamus. Since it is not practical to represent in hardware the large number of cells of these animal structures, only a cluster of cells of each layer is represented and data are moved past the cluster by shift registers.

A camera containing a single vidicon, that receives left and right views from mirrors, is shown in preference to two cameras because the former arrangement leads to much less uncertainty between the two optical paths.

In Fig. 13, left and right images of an object such as a rock are projected by the optics onto the face of the vidicon. Converted to digital form, the signals enter shift registers (1) which move the images past computing elements (2) and (3), which represent clusters of living cells. The filter planned for levels 2 and 3 is shown schematically at the upper left of Fig. 13. It consists of a central weight strongly positive, immediately peripheral less positive weights and more peripheral weakly negative weights.

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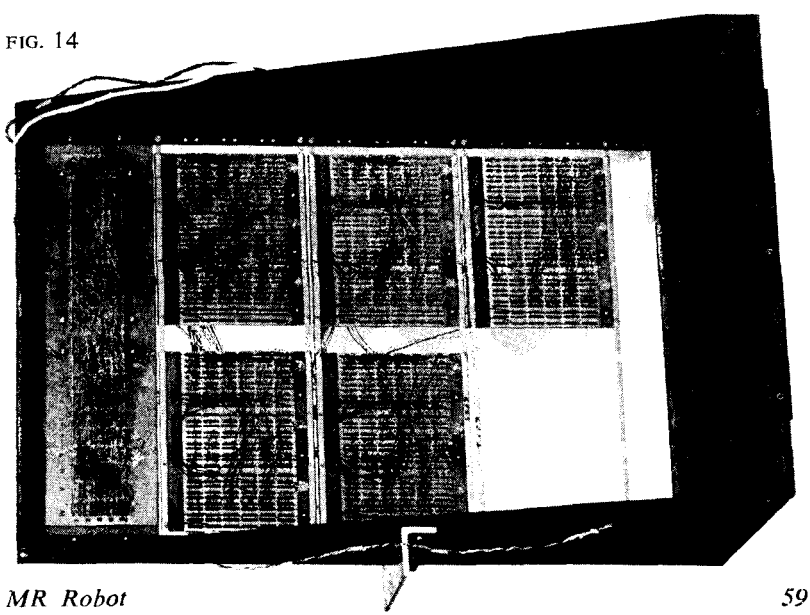
The images are advanced from left to right in the shift registers at the same rate that the tip of the electron beam in the vidicon advances. As data reach the right end of the top row, they are transferred to the left end of the next lower row. In this illustration, when the electron beam of the camera tube has swept 13 lines of the raster, the shift registers in the bank are full. From then on, for each new position of the electron beam, computations take place in the box behind the shift registers, and one digital word is discarded from the right end on the 13th row of shift registers.

Figure 14 shows test hardware under construction to perform levels 1, 2 and 3 computation, on five lines of the raster. Each of the lower five panels contains a shift register 6-bits deep. The registers shift the data past the computing element in the top panel. The medium-scale integrated circuits to be employed here, together with their wiring, can be packed into about 50 cu. in. With large-scale integrated circuits the volume could be 10 cu. in.

10. COMPUTATION OF RANGE

To perform second-stage computation, either a man or a robot needs a view from a second position. We refer to the two views as "left" and "right" since they are usually taken from the same horizontal baseline.

FIG. 14



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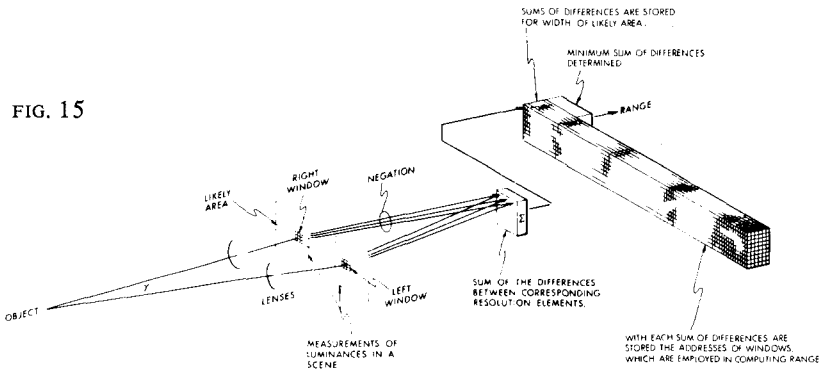
If the levels of robot computation pictured in Fig. 4 are for the left view, then either a second series of levels is needed for the right view or the levels need to be widened to accommodate both views. We have taken the latter approach in the design of the hardware.

Animals compute range from comparisons of left and right images, at several levels of computation, and from the angle between the axes of the two eyes, called the "convergence angle." The equipment shown in Fig. 7 has been programmed to automatically compute range by comparing

FIG. 15


SUMS OF DIFFERENCES ARE STORED FOR WIDTH OF LIKELY AREA.
MINIMUM SUM OF DIFFERENCES DETERMINED
RANGE
LIKELY AREA
RIGHT WINDOW
NEGATION
OBJECT
LENSES
LEFT WINDOW
SUM OF THE DIFFERENCES BETWEEN CORRESPONDING RESOLUTION ELEMENTS.
MEASUREMENTS OF LUMINANCES IN A SCENE
WITH EACH SUM OF DIFFERENCES ARE STORED THE ADDRESSES OF WINDOWS WHICH ARE EMPLOYED IN COMPUTING RANGE

areas, in the left and right level 2 images, called "windows" (see Fig. 15). To find a pair of windows that are viewing the same object, a window is first fixed on say, the left view, according to some criterion such as the presence of an edge: then a likely area is located in the other view. Since this area contains as many potential windows as resolution elements along the horizontal axis, the problem is to determine which of these windows corresponds to the one fixed in the left view. The simplest way is to compare luminances in the fixed window with corresponding luminances in the likely area, determine the difference and use this as a criterion to decide when a best match is obtained. From the data of the best match, range is computed by triangulation.

Employing this method, equipment shown in Fig. 7 automatically explores a likely area to determine the range of an object at 20 feet with an uncertainty of 1.5%. To perform the comparison over the entire likely area requires 16 seconds. The comparison will be performed over less area if the robot visually follows around the edge of an object or visually explores increasingly deep into the scene. In these latter cases, the visual subsystem of the robot starts with a known range and reaches out from it.

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In the robot we plan, the command computer, assisted by the relational computer, will determine what is seen by setting filters and thresholds in all stages of visual computation so as to match an internally-generated image with an incoming one. This "Keeping up to date the internal organizing system, that represents the external world, by an internal matching response to the current impact of the world upon the receptive system" is called "perception." "In a sense, the internal organizing system is continually making fast-time predictions on what is going on out there and what is likely to happen out there, and it takes anticipatory action to counter the small errors that might threaten its overall stability."

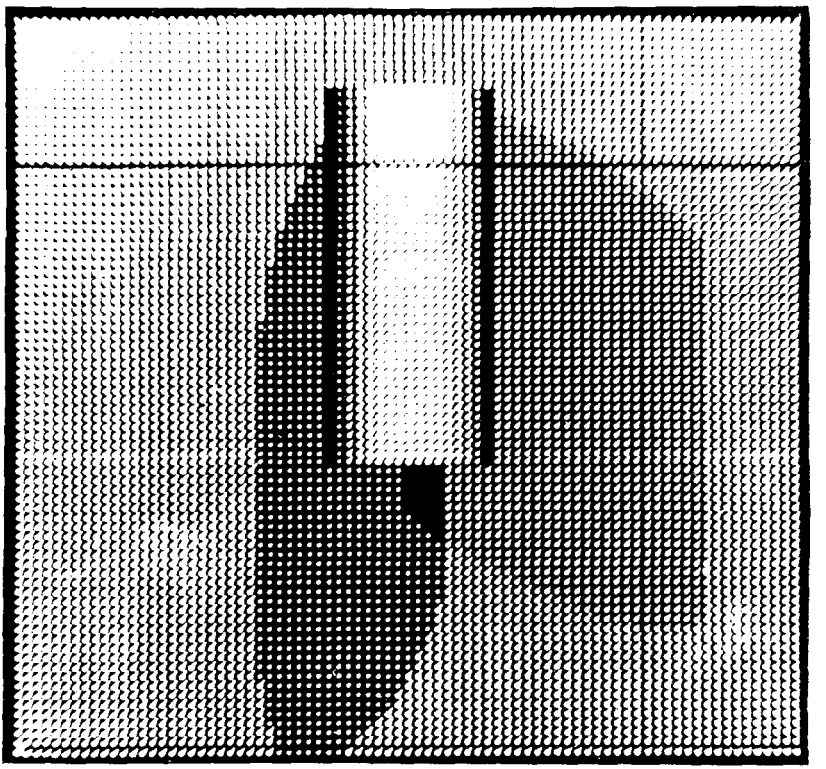

FIG. 16

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A line drawing with shading, transmitted to Earth for a scientist to view, aids his perceptual process, giving him clues to the presence of objects about which he can then demand more information. Within a robot, however, a line drawing with shading will be the result of interaction between the relational computer, setting filters and thresholds, and the second stage visual computer where these filters and thresholds are tried on incoming data. When equipped to perceive, a robot will make fast-time predictions, possibly as detailed as the computer-generated image of Fig. 16. Our general purpose computer formed Fig. 16 from the equation of a cylinder, its diameter, height and illumination. It appears that perception of the cylinder could take place in the first and second stages of visual computation if the filters there are continually changed, as data are shifted past them, to search for predicted luminances in each part of an internally-generated image.

12. THE CONCEPT OF A COMMAND COMPUTER

The purpose of a command computer, in an animal or robot, is to commit the entire system to one of a dozen or so mutually exclusive modes of behavior. An animal requires such a computer because it cannot "fight, go to sleep, run away, and make love all at once."

Our study of a possible Mars robot indicates that it, too, can only enjoy one mode of behavior at a time. Possible modes of such a robot are:

1. Look and feel
2. Advance
3. Retreat
4. Right itself if overturned
5. Maintain itself
6. Chart its environment
7. Rest

Perform incompatible experiments as follows:

8. Experiment A
9. Experiment B
10. Experiment C

"Look and feel" is a separate mode from "advance" because the robot must be stationary while either its camera or its arm is employed.

By "chart its environment" we mean that the robot, after advancing—or retreating—an appropriate distance, will establish what a surveyor calls a "station," and mark it with a transponder. Having determined the distance from the previous station and measured the angle between this

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and the second previous station, the robot can form a triangle in its memory to add to other triangles previously formed. By building triangle upon triangle, the robot establishes a grid with which it can determine how far it has gone and in what direction. Through this grid it can later pass, to return to points it has already visited.

Within each mode are the detailed sequences we call acts. Advance, for example, can be either slow, fast, or by turning. These details can be developed after the command computer has been designed to choose among the above modes.

The command computer should be capable not only of selecting the mode of behavior, in response to inputs from the environment, and the other computers, but of changing the way it responds to those inputs. Ability to change the record of conditions under which it selects a mode is called "plasticity" and is exemplified by conditioning and habituation.

The first simulation of a command computer represented only its mode-selecting ability. It was called S-RETIC where S stood for its ability to respond to both its present internal state and its spatially structured input. The second simulation is called STC-RETIC where T stands for its ability to be influenced by temporal aspects of the environment and C for conditioning and habituation. The properties of STC-RETIC together with several new features are now being designed into special hardware to be called H-RETIC.

The inputs to each of these RETICs represent connections from such subsystems as the visual, described in part above, and the contact, described in part in Section 16. The number of input channels to the present RETICs is very much smaller than will be required eventually from, say, the visual subsystem of the robot. In fact, the number of input channels—γ_1, to γ_{42} in Fig. 17—is only as many as needed to demonstrate the principles of operation.

13. HOW AN ANIMAL IS COMMANDED

In the core of the reticular formation of animals—retic—the selection of a mode of behavior is made by a matrix of fan-shaped cells embedded in regions that are stacked like poker chips. The input processes of each cell, its dendrites, give it both its fan-shape and its poker-chip-like thickness. Its output is an axon which traverses the long axis of the chip-like stack. Each cell in general receives signals from several parts of the brain, from many other reticular cells, especially those in its own neighborhood, and from several interoceptive and exteroceptive sensory pathways. Collectively, these cells decide which mode of behavior the animal will enter. In

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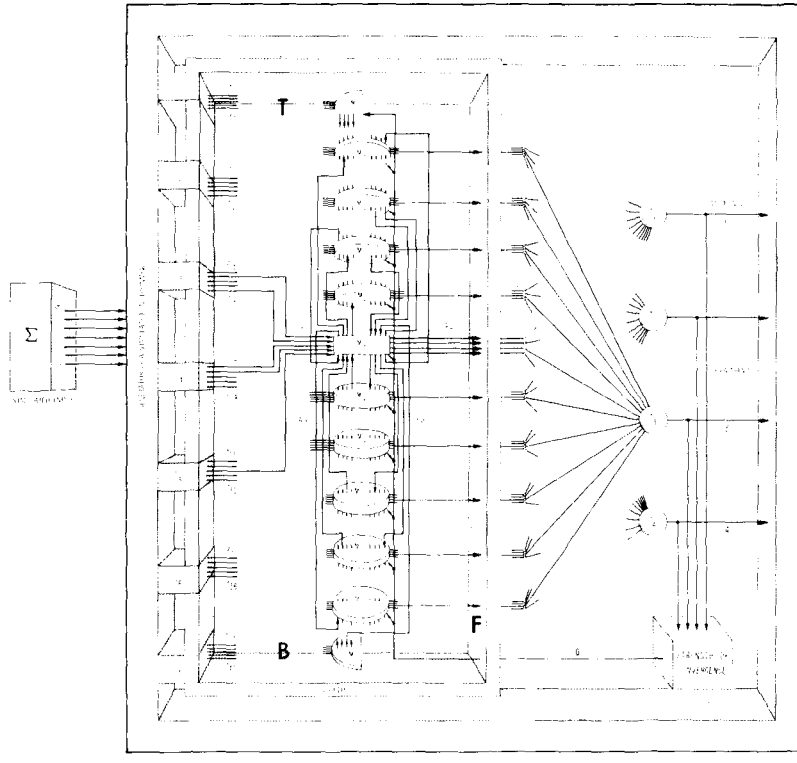

FIG. 17

its sharpest form, this assertion is only a hypothesis; but broadly speaking it is an evident biological fact.

The informational organization of retic is analogous to a board of medical doctors who must decide upon the treatment each of a series of patients must receive. Suppose there are twelve doctors on the board, each a generalist, as well as a specialist in a different field of medicine, and that they must select one of four possible treatments. Their deliberations resemble the process by which S-RETIC selects a mode of behavior.

Like the board of medical doctors, the command computer—retic—must commit its charge to a mode of behavior which in most cases is a function of the information that has played upon it only over the last second or so—signals indicating mission are part of this. It receives information that is vast in amount, but highly correlated between input channels and arrives at one of a small number of mutually exclusive modes of

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behavior in a dozen or so time steps, with minimal equipment and maximal reliability. After a mode is decided upon, it must send out control directives to the other agencies in its charge to turn them to their respective tasks. Finally, that part of the command computer which at any given time has the most crucial information has authority over the mode of operation.

14. FIRST SIMULATION OF A COMMAND COMPUTER, S-RETIC

Like retic, S-RETIC resembles a stack of poker chips, but each chip is now a computer module, M_i, and represents many retic cells. (See Fig. 17) Together the modules of S-RETIC decide on a mode of behavior in response to data from an overall environment that is static while each decision is being made. Note the word "overall." A major part of the environment of retic is the cerebral cortex where are stored the plans and goals of the animal. Although S-RETIC has only 42 binary input lines and chooses among only four modes of behavior, it demonstrates principles that can be applied on a much larger scale for a robot.

The 42 input lines, λ_i, are connected from sensory subsystems, S_i, to modules, M_i, in several-to-several, but not all-to-all fashion. The outer box in Fig. 17 represents a generator to simulate an environment formed in response to the input, Σ. At this stage of design, all σ_i and γ_i lines carry binary signals. All of the other lines into and out of modules carry numerical estimates of probabilities.

Each of the 12 logic modules computes from its input information the probability that each mode of behavior is best for the robot. After this initial guess, the modules communicate their decisions to each other over the low capacity ascending and descending lines. Then each module combines this information in a nonlinear fashion with new information coming into it to arrive at adjusted probabilities that each of the four modes is best for the robot. The module, in turn, communicates this adjusted guess to the modules to which it is connected above and below. The process repeats until six or more modules find one mode of behavior best for the robot with a probability greater than 0.5. This threshold is sensed by threshold units T in remote motor controls.

Each try at consensus, or convergence, is called a cycle of operation.

S-RETIC is a computer program operated now as part of the larger program described below. It always converges to the desired mode of behavior in less than 25 cycles, but 30 are allowed for it in a larger time period called an "epoch" with the new model described below.

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15. SECOND SIMULATION OF A COMMAND COMPUTER, STC-RETIC

In the second simulation of a command computer, the already-operating S-RETIC was expanded to provide interconnections between the a-parts of the modules (ω lines), short-and long-term memories (STM and LTM) in each a-part and channels through which the experimenter can reinforce each module. In addition, the number of γ lines to each module was increased to seven; the σ lines were increased to 13, and the mode of behavior of the robot (RM) was fed back to each a-part.

The new model is called STC-RETIC where S and T stand for a spatially and temporally changing environment, C for conditioning and habituation. Where each module of S-RETIC has a transformation network to form its initial guess, each module of STC-RETIC draws its initial guess from its LTM. During this and the ensuing epoch, it computes the effects of reinforcements, given it by the operator, and then adjusts its LTM accordingly. The result is conditioning, habituation and other forms of "plastic behavior." Given there are examples of the Pavlovian conditioning of a robot in a remote environment and the dropping out of this conditioning, called habituation. Development is also presented there as a form of plastic behavior.

The next step is to design a computer to be both a refinement of STC-RETIC and a more faithful reflection of the neurology of the core of the reticular formation. H-RETIC as it will be called, where H stands for hardware, will be organized much like the STC-RETIC with physically separate modules containing adaptive elements for memory.

16. CONTACT SUBSYSTEM

Design of a sense of touch has progressed to the point of planning a hand and arm to reach out and press lightly against surfaces to the front and side of the robot. Figure 15 shows the tactile hand with a single finger. A grasping hand is also being designed to be carried by a second arm.

As shown by Fig. 18, the shoulder provides three degrees of freedom: linear extension and rotations in elevation and azimuth. All motions are polar-centric, that is, centered on a common point, so that transformation of coordinates can be as simple as possible.

It is planned to map the probings of the finger in a somatic first-stage computer, similar to the visual first-stage computer described in Section 7. The z-axis of that mapping will be depth rather than luminance. Sud-

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den changes in depth will be detected by lateral inhibition, as they are in animals.

17. COMMAND OF THE COMMANDER?

Since both visual and tactile computation can be commanded to respond to some sizes and shapes more strongly than others, we are led to ask: What commands the command computer of an animal? Dr. McCulloch's answer is revealing: "Nothing. You can persuade or cajole the command computer, but you cannot command it." His statement is supported by his diagram in Fig. 2 where the influences upon retic are represented by the many connections to it. "There need to be connections from more than one sense, preferably at least three," he continues. Other influences upon retic are internal, such as the cerebral cortex, where are stored models of the environment, past and present, and future models in the form of goals. These influences may be stronger than external ones. Influences to a model of retic are represented by the S_i of Fig. 17.

Modes, which the retic of a vertebrate animal chooses among, are as follows.

1. sleep
2. eat
3. drink
4. fight
5. flee
6. hunt for prey or fodder
7. explore (or search)
8. urinate
9. defecate
10. groom
11. mate (or sex)
12. give birth or lay egg
13. mother the young
    (e.g., suckle, hatch, retrieve)
14. build or locate nest
15. innate forms of behavior
    unique to the species, such as
    migrate
    hibernate
    gnaw
    hoard

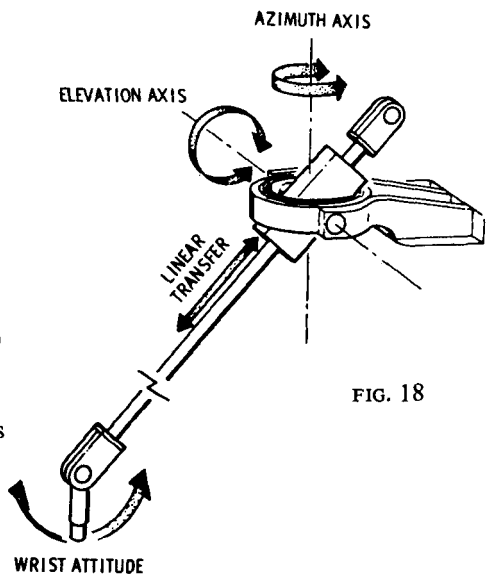

FIG. 18

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A comparable list for a Mars robot is given in Section 12.

We can imagine how a man's retic selects among his possible modes of behavior. Vision, as we pictured it in Section 7, consists of both the feed-inward of raw sensory data and the feed-outward of signals to adjust filters to match internally-generated images. Touch, hearing and kinesthesia appear to operate in similar fashion. Sensory inputs, therefore, of the kind represented by the S_i of Fig. 13, represent information from external and internal sensors and internal computers.

Consider the actions of a soldier on sentry duty at an advanced post in enemy country. He is expected to hold his filters to match the stimuli he has been taught to expect from the enemy: the shape of his face, the color of his uniform, his manner of fighting, et cetera. If the soldier hears the snap of a breaking twig, turns toward the sound, and receives from its direction images that match the projections of his stored models, he may classify the sound and the sight as "enemy." What the soldier does next depends upon other models stored in his relational computer. If circumstances appear to favor combat, the sentry may fight (mode 4). If circumstances appear overwhelmingly adverse, the sentry may turn and run (mode 5). Circumstances that cause his command computer to select a mode are the number of the enemy, its armament, et cetera, as these are recognized by the process of generating projections and comparing these at the filters with incoming images. Thus the enemy can persuade or cajole the soldier's command computer.

Similarly, the Martian environment should be able to persuade or cajole the command computer of a Mars robot, in cooperation with very many fewer relations than are required for a human being, such as a sentry. As far as we know the Mars robot will not have to contend with enemies and, therefore, will not have to fight or flee. Nor will it have to enter any of the other modes which an animal has to enter in order to eat and reproduce.

The ten modes suggested in Section 12 are very much reduced versions of the requirements of an animal. Instead of the elaborate mode of behavior to hunt, are the much simpler ones to advance, retreat, and look-and-feel.

18. STAGES IN THE DEVELOPMENT OF A ROBOT

The system we have just described can be achieved, we believe, by such a process of designing, simulating, and testing as we have described for the development of the separate computers.

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A camera-computer chain of the kind described in Sections 7 through 9 can be packaged so as to be mobile. A possible mobile camera-computer chain is shown in Fig. 19. To eliminate the need for its own power supply and transmitter to Earth, it is connected to a Mars lander by a cable which it pays out from a spool at its center. To permit it to look from side to side without moving, its camera employs a rotating prismatic mirror which reflects the light of the scene through both left and right optical paths, to photocells which transduce luminances to voltages. The voltage amplitudes, when converted to digital words, then enter shift registers, to move past computing elements in the manner described in Section 9. Vertical scan is attained by turning the drum that holds the camera.

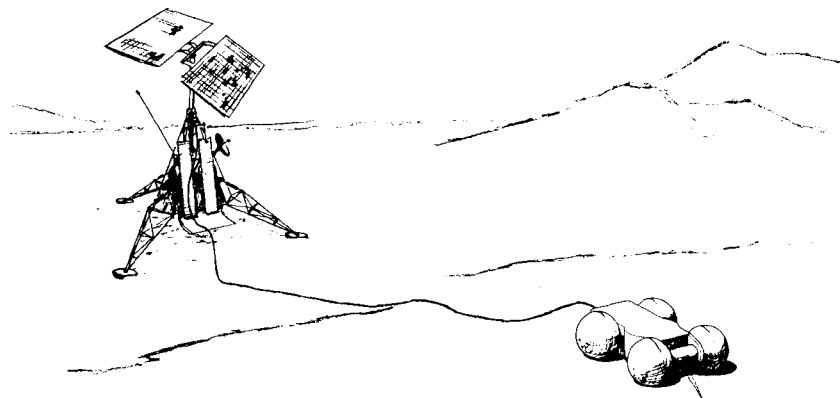

FIG. 19. *Proposed mobile data-acquiring element for a Mars landing.*

In initial experiments, the visual first-stage computer can be at the far end of the cable in the lander. When a lightweight visual first-stage computer has been completed, it can be placed within the mobile data-gathering element.

The command computer will not be tied in initially, the command being exercised by the earth operator. When the command computer has reached the stage of development where it can be tied in, it can be built into a robot that is physically separate from the lander, in a configuration such as that shown in Fig. 20. This design shows, for test purposes, a stereo television camera mounted in gimbals on a commercially-available tractor. The gimbal mounting of the camera permits it to look forward, sideward, up, down and backward. Beside the camera is the arm described in Section 15. The rubber tires would be replaced for Mars travel by wire-mesh tires.

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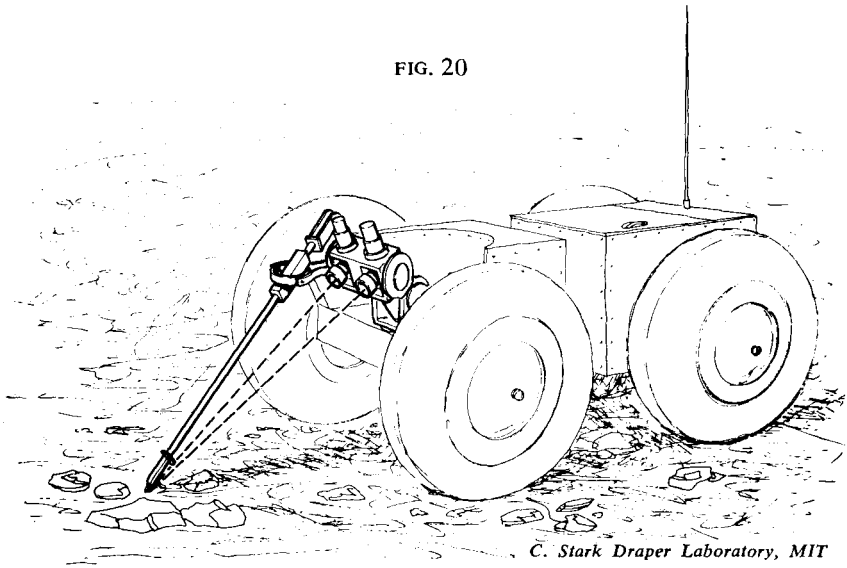
FIG. 20



C. Stark Draper Laboratory, MIT

19. COMPARISON WITH OTHER ROBOT PROJECTS

Perhaps because it is directed toward development of the properties of the computers described in Section 2, ours is the only robot project with a binocular TV camera as input, a visual second-stage computer to employ this binocular input for precision computation of range, and a command computer to receive simultaneous inputs from several senses and decide what class of thing the robot should do.

However, the visual computers and the command computer are still operating separately while in other robot projects assemblies of computers and external equipment are already operating together. Eye-computer-arm-hand systems are in operation at Project MAC, M.I.T. and the Department of Computer Science at Stanford University. A computer-arm-hand system is in operation at the Department of Mechanical Engineering, M.I.T. An eye-computer-vehicle system is in operation at Stanford Research Institute (SRI). Out of the efforts of the projects have come list processing languages which we may use in simulating a relational computer. Other contributions are speech recognition, the kinematics of manipulators under computer control, the mapping of the space in which a manipulator operates and recognition of visual contiguity.

Since we are all engaged in processing increasingly large volumes of data, reward goes to the one who discovers a method of extracting useful data. At Project MAC and Stanford the reward can take the form of a

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doctor's degree; at SRI and our project, which are more equipment oriented, the reward is to have either the equipment or a simulation of it work. This reward is also present at the two universities; and SRI and we also do theoretical work.

Aside from the amount of equipment in operation, the greatest difference between our project and the other three is in the way we use the life sciences. All of us use this information since we are all trying to make computers and other hardware do what until now, only animals have done. However, we give primary attention to anatomy and physiology, secondary attention to psychology and invention, while other projects use a reverse emphasis. We make an exhaustive search of the literature on each animal "computer" we investigate and attempt to create, within the constraints of technology, a working model of the "computer."

Once we have achieved a working model we proceed to improve it and in doing so may excel nature.

20. CONCLUSION

To some, the work reported here will appear to be slavish imitation of the vertebrate nervous system. It appears to us, on the other hand, to be good engineering practice. When something does what you want it to do and is already miniaturized, why not copy it?

The copy is made only in principle. Visual computers are time-shared elements, past which data is moved by shift registers. The command computer, on the other hand, is designed to be built of modules, each of which forms a larger portion of the whole than do cells in retic. In fact, the modules and the cells are similar only in their mathematics.

To quote Dr. McCulloch, "We use the word 'robot' in two ways. The first, and less important, is as a machine that performs isolated functions of a human being. The second, and more important, is as a description of life applicable to either living things or machines. Such a description is indifferent to whether the system is man-made or grown, whether it is built of hardware or living cells. This is a central theme of cybernetics: to use the same logic and mathematics to describe men and machines. Norbert Wiener looked at control this way. We are looking at both command and control. Thus, in the more important sense, a robot is a prescription for a system that until recently could be achieved only by the growth of living cells but is becoming something we can manufacture." ■

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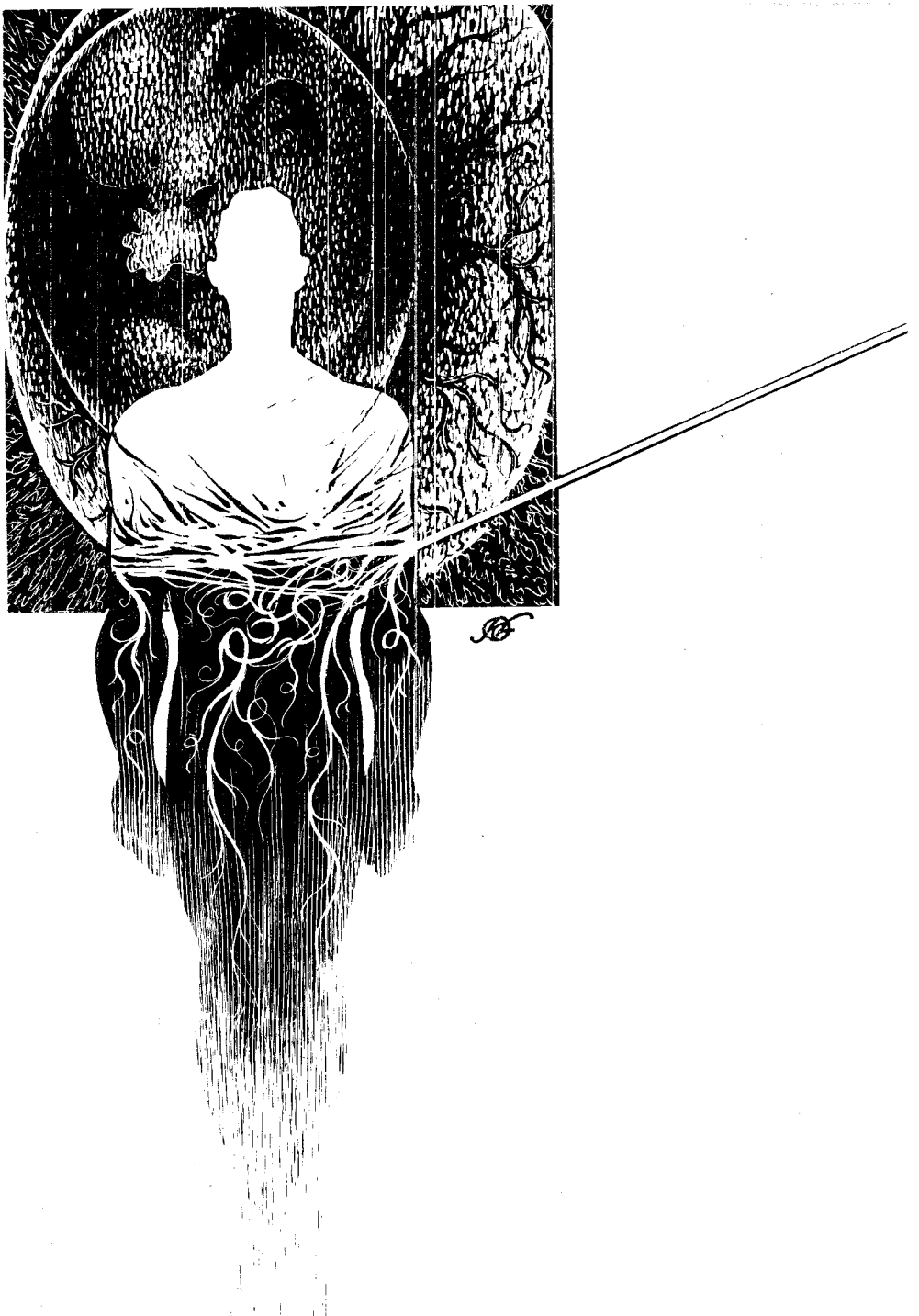

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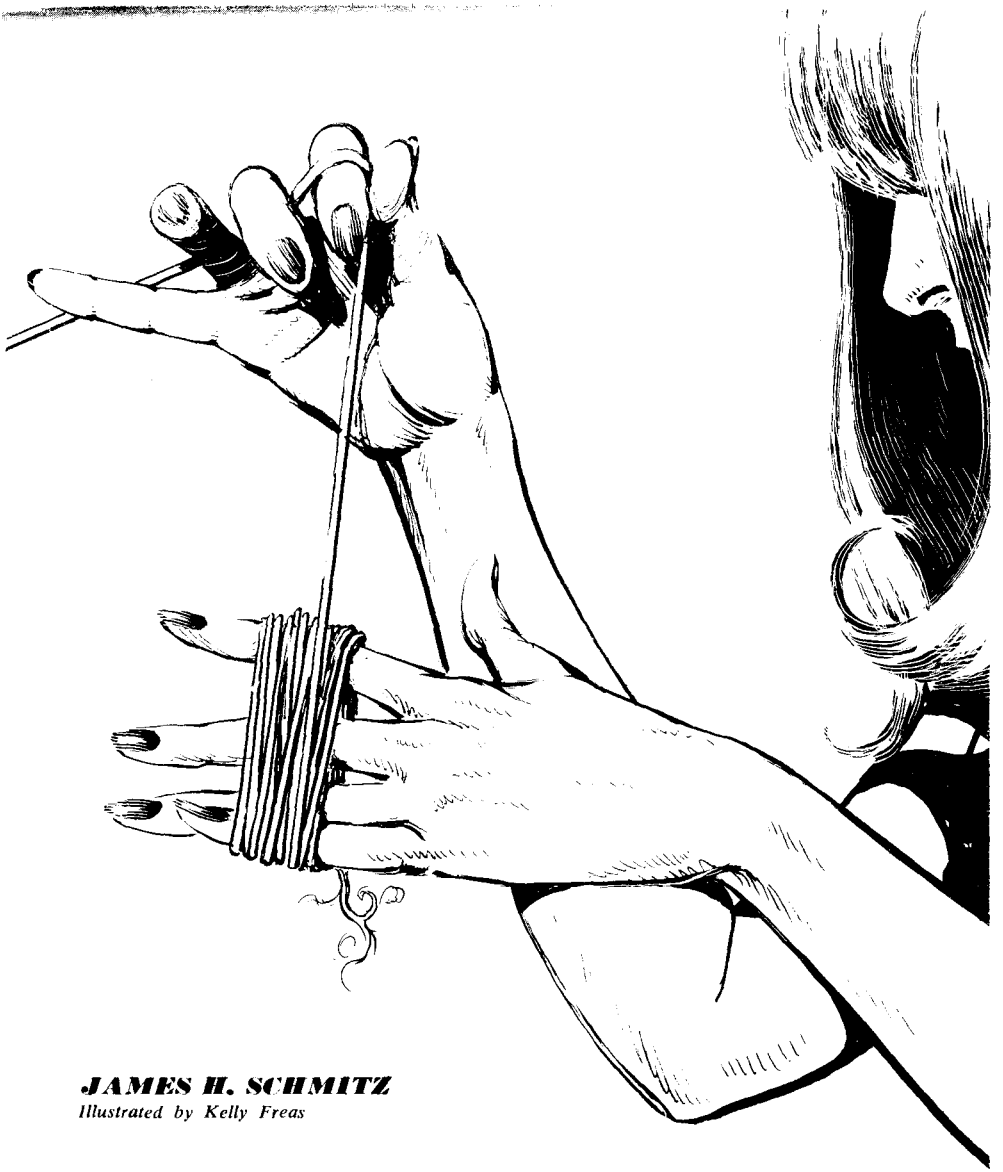

JAMES H. SCHMITZ
Illustrated by Kelly Freas

Kyth Interstellar, a detective agency,
had a problem that not even their highly skilled operatives
could handle—without Telzey, their Resident Witch!

resident witch

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I

Telzey checked in at the Morrahall Hotel in Orado City that evening, had an early dinner, and then locked herself in her room. The impression she'd left at Pehanron College was that she would be spending the night with her family. Her parents, on the other hand, naturally assumed she was at the college. She'd arranged with the ComWeb Service to have calls coming in at college, at home, or to her car, transferred to the hotel room—if the caller, having been informed that she was busy and much preferred not to be disturbed before morning, felt there was justification enough for intruding on her privacy.

The semifinals of the annual robochess district championship series had begun, and she was still well up among the players. There should be two or three crucial games tonight, very little sleep. She wanted *all* the seclusion she could get.

She got into a casual outfit, settled down at the set, dialed herself into the series. Five minutes later, she was fed an opening move, an easy-looking one. She countered breezily. Six moves on, she was perspiring and trying to squirm out of an infernally ingenious trap. Out of it, though not unscathed, just ahead of deadline, she half closed a rather nasty little trap of her own.

Time passed in blissful absorption.

Then the ComWeb rang.

Telzey started, frowned, glanced at the instrument. It rang again. She pushed the Time Out button on the set, looked at her watch, switched on the ComWeb. "Yes?"

"A caller requests override, Miss Amberdon," the ComWeb told her.

"Who is it?"

"The name is Wellan Dasinger."

"All right." Telzey clicked in nonvisual send, and Dasinger's lean tanned face appeared in the screen. "I'm here," she said. "Hello, Dasinger."

"Hello, Telzey. Are we private?"

"As private as we can be," she assured him. Dasinger was the head of Kyth Interstellar, a detective agency to which she'd given some assistance during the past year, and which in turn was on occasion very useful to her.

"I need information," he said. "Quite urgently—in your special study area. I'd like to come out to Pehanron and talk to you. Immediately, if possible." This was no reference to her law studies. Dasinger knew she was a psi; but neither he nor she referred to psi matters directly on a ComWeb. He added, "I realize it can't be the most convenient hour for you."

Dasinger wasn't given to overstatement. If he said a matter was quite urgent, it was as urgent as matters could get. Telzey depressed the Concede button on the robo-

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chess set, thereby taking herself out of the year's series. The set clicked off. "The hour's convenient, Dasinger," she said. "So is the location."

"Eh?"

"I'm not at the college. I took a room at the Morrahall for the night. You're at the agency?"

"I am." The Kyth offices were four city block complexes away. "Can I send someone over for you?"

"I'll be down at the desk in five minutes," Telzey told him.

She slipped into sportswear, fitted on a beret, slung her bag over her shoulder, and left the room.

There were three of them presently in Dasinger's private conference room. The third one was a Kyth operator Telzey hadn't met before, a big blond man named Corvin Wergard.

"What we want," Dasinger was saying, "is a telepath, mind reader—the real thing. Someone absolutely dependable. Someone who will do a fast, precise job for a high fee, and won't be too fussy about the exact legality of what he's involved in or a reasonable amount of physical risk. Can you put us in contact with somebody like that? Some acquaintance?"

Telzey said hesitantly, "I don't know. It wouldn't be an acquaintance; but I *may* be able to find somebody like that for you."

"We've tried the listed professionals," Wergard told her. "Along with some unlisted ones who were recommended to us. Mind readers; people with telepathic devices. None of them would be any good here."

Telzey nodded. No one like that was likely to be much good anywhere. The good ones stayed out of sight. She said, "It might depend on exactly what you want the telepath to do; why you want him to do it. I know it won't be anything unethical, but he'll want to be told more than that."

Dasinger said, "It may concern a murder already carried out, or a murder that's still to come. If it's the last, we want to prevent it. Unfortunately, there's very little time. Would you like to see the file on the case? It's a short one."

Telzey would. It was brought to her.

The file was headed: "Selk Marine Equipment." Which was a company registered on Cobril, the water world eighteen hours from Orado. The brothers Noal and Larien Selk owned the company, Larien having been involved in it for only the past six years. For the past four years, however, he alone had been active in the management. Noal, who'd founded the company, had been traveling about the Hub during that time, maintaining a casual connection with the business.

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A week ago, Noal had contacted the Kyth agency's branch on Cobril. He'd returned unexpectedly, found indications that Larien was syphoning off company funds, and apparently investing them in underworld enterprises on Orado. He wanted the agency to start tracing the money on Orado, stated he would arrive there in a few days with the evidence he'd accumulated.

He hadn't arrived. Two days ago, Hishee Selk, Larien's wife, appeared at the agency's Cobril branch. She said Larien had implied to her that Noal had tried to make trouble for him and would pay for it. From his hints, she believed Larien had arranged to have Noal kidnapped and intended to murder him. She wanted the agency to find Noal in time to save his life.

The Selk file ended there. Visual and voice recordings of the three principals were included. Telzey studied the images, listened to the voices. There wasn't much obvious physical resemblance between the brothers. Larien was young, athletically built, strikingly handsome, had an engaging smile. Noal, evidently the older by a good many years, seemed a washed-out personality—slight, stooped, colorless. Hishee was a slender blonde with slanted black eyes and a cowed look. Her voice matched the look; it was low and uncertain. Telzey went through that recording again, ignoring Hishee's words, absorbing the voice tones.

She closed the file then. "Where's the rest of it?"

"The rest of it," said Dasinger, "is officially none of the Kyth agency's business at the moment. Hence it isn't in the agency files."

"Oh?"

"You know a place called Joca Village, near Great Alzar?"

She nodded. "I've been there."

"Larien Selk acquired an estate in the Village three months ago," Dasinger said. "It's at the northeast end, an isolated cliffside section overlooking the sea. We know Larien is there at present. And we've found out that Noal Selk was in fact kidnapped by professionals and turned over to Larien's people. The probability is that he's now in Larien's place in Joca Village. If they try to move him out of there, he'll be in our hands. But that's the only good prospect of getting him back alive we have so far. Larien has been given no reason to believe anyone is looking for his brother, or that anyone but Hishee has begun to suspect Noal is missing. That's our immediate advantage. We can't afford to give it up."

Telzey nodded, beginning to understand. Joca Village was an ultra-exclusive residential area, heavily guarded. If you weren't a resident, or hadn't been issued a pass by a resident, you didn't get in. Passes were carefully checked

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at the single entrance and had to be confirmed. Overhead screens barred an aerial approach. She said, "And you can't go to the authorities until you have him back."

"No," Dasinger said. "If we did, we'd never get him back. We might be able to pin murder on Larien Selk later, though that's by no means certain. In any case, it isn't what we're after." He hesitated, said questioningly after a moment, "Telzey?"

Telzey blinked languidly.

"Telzey—" Dasinger broke off, watching her. Wergard glanced at him. Dasinger made a quick negating motion with his hand. Wergard shifted his attention back to Telzey.

"I heard you," Telzey said some seconds later. "You have Hishee Selk here in the agency, don't you?"

Wergard looked startled. Dasinger said, "Yes, we do."

"It was her voice mainly," Telzey said. "I picked her up on that." She looked at Wergard. "Wergard can't really believe this kind of thing is real."

"I'm trying to suspend my doubts," Wergard said. "Bringing in a mind reader wasn't my idea. But we could use one only too well here."

Dasinger said, "All right to go on now, Telzey?"

"Oh, yes," she said. "I was gone for only a moment. Now I'm making contact, and Hishee looks wide open. She's very easy!" She straightened up in her chair. "Just what do you want your mind reader to do?"

Dasinger said to Wergard, "What Telzey means is that, having seen what Hishee Selk looks like, and having heard her voice, she gained an impression of Hishee's personality. She then sensed a similar impression around here, found a connection to the personality associated with it, and is now feeling her way into Hishee's mind. Approximately correct, Telzey?"

"Very close." For a nonpsi, Dasinger did, in fact, have a good understanding of psi processes.

"Now as to your question," he went on. "When Larien Selk bought the place in Joca Village, he had it equipped with security devices, installed by Banance Protective Systems, a very good outfit. During the past week, Banance added a few touches—mainly a Brisell pack and its handler. At the same time, the Colmer Detective Agency in Great Alzar was employed to provide round-the-clock guards, five to a shift, stationed directly at the house, behind the pack. However, we've obtained copies of the Banance security diagrams which show the setup on the grounds. And, of course, there are various ways of handling guards."

"You mean you can get into Joca Village and into the house?"

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"Very likely. One of the residents is an agency client and has supplied us with Village passes. Getting on the Selk estate and into the house without alerting security presents problems, but shouldn't be too difficult. Everything is set up to do it now, two or three hours after nightfall at Joca Village. It's after we're inside the house that the matter becomes really ticklish."

Wergard said, "It's a one-shot operation. If we start it, it has to come off. We can't back away, and try again. Either Noal will be safe before his brother realizes somebody is trying to rescue him, or he'll have disappeared for good."

Telzey considered. It was easy enough to dispose of a human being instantly and tracelessly. "And you don't *know* Noal's in the house?" she said.

"No," Dasinger said. "There's a strong probability he's there. If we can't do better, we'll have to act on that probability tonight, because every hour or delay puts his life—if he's still alive—in greater danger. If he isn't there, Larien is the one person in the house who's sure to know where he is. But picking up Larien isn't likely to do Noal any good. He's bound to have taken precautions against that, and again Noal, wherever he is, will simply vanish, along with any evidence pointing to him. So we come back to the mind reader—somebody who can tell us from Larien's mind exactly where Noal is and what we can do about it, before Larien knows we're in the house."

"Yes, I see," Telzey said. "But there're a number of things I *don't* understand here. Why does Larien—" She broke off, looked reflective a moment, nodded. "I can get that faster from Hishee now! It's all she's thinking about."

II

Larien Selk, legally and biologically Noal's junior by twenty-five years, was, in the actual chronology of events, the older brother. He'd been conceived first by three years. The parents were engaged in building up a business and didn't want to be burdened with progeny taxes. The Larien-to-be went to an embryonic suspense vault. When Noal was conceived, the family could more readily afford a child, and the mother decided she preferred giving natural birth to one.

So Noal was born. His parents had no real wish for a second child. They kept postponing a decision about the nameless embryo they'd stored away, and in the end seemed almost to have forgotten it. It wasn't until they'd died that Noal, going through old records, found a reference to his abandoned sibling. Somewhat shocked by his parents' indifference, he had Larien brought to term. When his brother grew old enough to understand the situation, Noal explained how he'd come to take his place.

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Larien never forgave him. Noal, a shrewd enough man in other respects, remained unaware of the fact. He saw to it that Larien had the best of everything—very nearly whatever Larien wanted. When he came of age, Noal made him a partner in the company he'd founded and developed. Which put Larien in a position to begin moving against his brother.

Hishee was his first move. Hishee was to have married Noal. She was very young, but she was fond of him and a formal agreement wasn't far away. Then Larien turned his attention on Hishee, and the formal agreement was never reached. Hishee fell violently in love.

Noal accepted it. He loved them both; they were near the same age. But he found it necessary to detach himself from them. He waited until they married, then turned the effective management of the company over to Larien, and began traveling.

Larien set out casually to break Hishee. He did an unhurried thorough job it, gradually, over the months, eroding her self-esteem and courage in a considered variety of ways. He brought her to heel, continued to reduce her. By the time Noal Selk came back to Cobril, Hishee was too afraid of Larien, too shaken in herself, to give her brother-in-law any indication of what had happened.

But Noal saw it. Larien had wanted him to see it, which was a mistake. Larien wasn't quite as well covered in his manipulation of the company's assets as he'd believed.

Noal, alerted to Larien's qualities, became also aware of that. He made a quiet investigation. It led him presently to the Kyth detective agency.

Then he disappeared.

Dasinger said dryly, "We'd put you on the Kyth payroll any time, Telzey! It took us some hours to extract half that information from Hishee. The rest of it checks. If Larien thinks it's safe, he'll see Noal broken completely before he dies. No doubt he's made ingenious arrangements for that. He's an ingenious young man. But the time we have for action remains narrowly limited."

"He doesn't know Hishee's gone?" Telzey asked.

"Not yet. We have that well covered. We had to take her out of the situation; she'd be in immediate danger now. But it's an additional reason for avoiding delay. If Larien begins to suspect she had courage enough left to try to save Noal, he'll destroy the evidence. He should be able to get away with it legally, and he knows it."

Telzey was silent a moment. There were some obscure old laws against witchcraft, left deliberately unchanged, very rarely applied. Aside from that, the Federation was officially unaware of the exis-

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tence of psis; a psi's testimony was meaningless. Legally then, it was probable enough that Larien Selk could get away with the murder of his brother. She doubted he'd survive Noal long; the private agencies had their own cold rules. But, as Dasinger had said, that wasn't what they were after.

She said,"Why do you want to plant the telepath in the house? If he's good enough, he should be able to tap Larien's mind from somewhere outside Joca Village, though it probably would take a little longer."

Wergard said, "One of the Banance security devices is what's known technically as a psi-block. It covers the outer walls of the house. Larien shares some of the public superstitions about the prevalence of efficient mind-reading instruments. Presumably the block would also stop a human telepath."

She nodded. "Yes, they do."

"When he's outside one of his psi-blocked structures, he wears a mind shield," Wergard said. "A detachable type. If we'd known about this a little earlier, we might have had an opportunity to pick him up and relieve him of it. But it's too late now."

"Definitely too late," Dasinger agreed. "If you think you can find us a telepath who's more than a hit-and-miss operator, we'd take a chance on waiting another day, if necessary, to bring him in on it. But it would be taking a chance. If you can't get one, we'll select a different approach and move tonight."

Telzey said, "A telepath wouldn't be much good to you if Larien happens to be probe-immune. About one in eight people are."

"Seven to one are good odds in the circumstances," Dasinger said. "Very good odds. We'll risk that."

"They're better than seven to one," Telzey told him. "Probe-immunes usually don't know that's what they are, but they usually don't worry about having their minds read either. They feel safe." She rubbed her nose, frowning. "A Psychology Service psi could do the job for you, and I can try getting one. But I don't think they'll help. They won't lift a finger in ordinary crime cases."

Dasinger shook his head. "I can't risk becoming involved with them here anyway. Technically it's an illegal operation. The Kyth agency won't be conducting it unless we come up with evidence that justifies the illegality. I resigned yesterday, and Wergard and some others got fired. We'll be acting as private citizens. But that's also only a technicality, and the Service is unpredictable. I don't know what view they'd take of it. We might have them blocking us instead of helping. Can you find someone else?"

She nodded. "I can get you a telepath. Just one. The other psis I

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know won't touch it. They don't need the fee, and they don't want to reveal themselves—particularly not in something that's illegal."

"Who's the one?" Wergard asked.

"I am, of course."

They looked at her a moment. Wergard said, "That isn't what we had in mind. We want a pro who'll take his chances for the money he's getting. We needed information from you, but no more than that."

Telzey said, "It looks like it's turned into more than that."

Wergard said to Dasinger, "We can't get her involved."

"Corvin Wergard," Telzey said.

He looked back at her. "Yes?"

"I am not reading your thoughts," she said. "I don't have to. You've been told who I am, and that I'm sixteen years old. So I'm a child. A child who comes of a very good family and has been very carefully raised. Somebody really too nice to get shot tonight, if something goes wrong, by a Colmer guard or Joca security people, or ripped up by Brisells. Right?"

Wergard studied her a long moment. "I may have had such notions," he said then. "Perhaps I've been wrong about you."

"You've definitely been wrong about me," Telzey told him. "You didn't know enough. I've been a psi, a practicing psi, for almost a year. I can go through a human life in an hour and know more about it than the man, or woman, who's living it. I've gone through quite a few lives, not only human ones. I do other things that I don't talk about. I don't know what it exactly makes me now, but I'm not a child. Of course, I *am* sixteen years old and haven't been that very long. But it might even be that sometimes people like you and Wellan Dasinger look a little like children to me. Do you understand?

"I'm not sure," Wergard said. He shook his head. "I believe I'm beginning to."

"That's good. We should have an understanding of each other if we're to work together. The agency would save the fee, too," Telzey said. "I don't need it. Of course, there may come a time when I'll ask you to stick your neck out for something I'd like to have done."

Wergard asked Dasinger, "Has that been the arrangement?"

Dasinger nodded. "We exchange assistance in various matters." He added, "I still don't want you in this, Telzey. There will be risks. Not unreasonable ones; but our people are trained to look out for themselves in ways you're not. You're too valuable a person to be jeopardized on an operation of this kind."

"Then I can't help you help Noal Selk," she said. "I'd like to. But the only way I can do it is by going along with you tonight. It

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would take more time than you have to hunt around for somebody else."

Dasinger shook his head. "We'll use a different approach then. With a little luck, we can still save Noal. He isn't your problem."

"How do you know?" Telzey said. "He mightn't be if he were someone I'd only heard about. If I helped everybody I could help because I happen to be a psi, I'd have no time for anything else the rest of my life. There isn't a minute in the day I couldn't find someone somewhere who needs the kind of help I can give. I'd keep busy, wouldn't I? And, of course, everything I did still wouldn't make any real difference. There'd always be more people needing help."

"There would be, of course," Dasinger agreed.

She smiled. "It gave me a bad conscience for a while, but I decided I wasn't going to get caught in that. I'll do something, now and then. Now, here I've been in Hishee Selk's mind. I'm still in her mind. I know her, and Noal and Larien as she knows them—perhaps better than most people know the members of their family. So I can't say their problem isn't my problem. It wouldn't be true. I simply know them too well."

Dasinger nodded. "Yes, I see now."

"And I," said Wergard, "made a big mistake."

Dasinger looked at his watch. "Well, let's not waste time. The plan goes into operation in thirty minutes. Telzey, you're going high style—Joca Village level. Wergard, take her along, have her outfitted. Scratch Woni. We won't need her."

III

The only entry to the secluded Selk estate in Joca Village was a narrow road winding between sheer cliff walls. Two hundred yards along the road was a gate; and the gate was guarded by Selk employees.

Up this road came a great gleaming limousine, preceded by a cry of golden horns. It stopped near the gate, and Larien Selk's three guards moved forward, weapons in their hands, to instruct the intruders to turn back. But they came prepared to give the instruction in as courteous a manner as possible. It was unwise to offer unnecessary offense to people who went about in that kind of limousine.

Its doors had opened meanwhile; and, gaily and noisily, out came Wergard in a Space Admiral's resplendent and heavily decorated uniform; Dasinger with jeweled face mask, a Great Alzar dandy; Telzey, finally, slender and black-gowned, wearing intricate silver headgear. From the headgear blazed the breath-stopping beauty of two great star hyacinths, proclaiming her at once to be the

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pampered darling of one who looked on ordinary millionaires as such millionaires might look on the lowest of bondsmen.

Weapons most tactfully lowered, the guards attempted to explain to these people—still noisily good-natured, but dangerous in their vast arrogance and wealth and doubly unpredictable now because they were obviously high on something—that a mistake had been made, that, yes, of course, their passes must be honored, but this simply didn't happen to be a route to the estate of the Askab Odarch. In the midst of these respectful explanations, an odd paralysis and confusion came to the guards. They offered no objection when men stepped out from behind the limousine, gently took their weapons and led them toward the small building beside the gate, where Wergard already was studying the gate controls. The study was a brief one: the gate's energy barrier, reaching up to blend into the defense shield of Joca Village above, winked out of existence a minute later and the great steel frames slid silently back into the rock walls on either side. The instruments which normally announced the opening of the gate to scanners in the Selk house remained inactive.

The limousine drifted through and settled to the ground beside the road. The gate closed again, and the vehicle was out of sight. Joca Village security patrols would check this gate, as they did the gates of all Village residents, several times during the night, and leaving the limousine outside would have caused questions. Whether suspicions were aroused otherwise depended mainly on whether someone began to wonder why Larien Selk's three gate guards were men who hadn't been seen here before. Measures had been taken to meet that contingency, but they were measures Dasinger preferred not to bring into play at present. The goal was to get Telzey into the house quickly, find out where Noal Selk was, pick him up if he were here and get back out with him, with no more time lost than could be helped. Whether or not his brother came along would be determined by what they discovered. With luck in either case, they'd be out of Joca Village again, mission accomplished, before the next patrol reached the Selk estate.

Only Dasinger, Wergard and Telzey had gone through with the limousine. They emerged from it quickly again, now in fitted dark coveralls, caps and gloves, difficult to make out in the nighttime half-dark of the cliff road, and with more sophisticated qualities which were of value to burglars seeking entry into a well-defended residence. They moved silently along the road in the thick-soled sound-absorbing boots which went with

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the coveralls, Wergard carrying a sack. The road led around a turn of the cliffs; and a hundred yards beyond the turn, Dasinger said, "You might give them the first blast from here."

They stopped. The rock wall on the left was lower at this point, continued to slope downward along the stretch of road ahead. Wergard opened the sack and took out a tube a foot long and about three inches in diameter. He lifted the tube, sighting along it to a point above the cliffs on the left, pressed a trigger button. Something flicked silently out of the mouth of the tube and vanished in the dark air. They went on fifty yards, stopped again, and Wergard repeated the performance. The next time they stopped, the cliff on the left had dwindled to a rocky embankment not much more than twelve feet high. Larien Selk's big house stood in its gardens beyond the embankment, not visible from here.

They stood listening.

"It's got them," Wergard said

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then, low-voiced. "If it hadn't, they'd be aware of us by now, and we'd hear them moving around."

"Might as well give them a third dose—to be sure," Dasinger remarked.

"Why not?" Wergard agreed. He took a third tube from the sack, adjusted its settings, squinting through the dusk, then discharged its contents up across the embankment. The copies of the diagrams, briefly borrowed from the files of Banance Protective Systems, had showed that beyond the fence above the embankment was the area patrolled by a dozen Brisell dogs, dependable man-killers with acute senses. The three canisters Wergard had fired into the area were designed to put them out of action. They contained a charge stunning canine olfactory centers, approximately equivalent, Telzey had gathered, to the effect which might have been achieved by combining the most violent odors obtainable in their heaviest possible concentration, and releasing the mix in a flash of time. The canine mind thus treated went into prolonged dazed shock.

"Getting anything so far?" Dasinger asked her.

She nodded. "There is a psi-blocked area around. It seems to be where the house is. If Noal and Larien are here, they're in that area."

She'd kept bringing up impressions of both Selk brothers on the way from Orado City—things she knew about them from Hishee Selk's recalls and reflections, and from the visual and auditory recordings her own senses had registered. After they'd passed through the gate, she'd been searching mentally for anything which might relate to those impressions, blocking off her awareness of Wergard and Dasinger. There'd been occasional faint washes of human mind activities hereabouts, but they carried unfamiliar patterns. She'd fastened on the most definite of those and was developing the contact when Dasinger addressed her.

She mentioned this now, added, "It's one of the Colmer guards outside the house. Nobody's expecting trouble there. I can't tell yet what he's thinking, but nothing's worrying him."

Dasinger smiled. "Good! Keep your inner ears tuned to the boy! That could be useful. Let's move on—starting from here, as ghosts."

He reached under his collar as he spoke, abruptly became a bulkier smoky figure, features distorted though still vaguely distinguishable. There was a visual dispersion effect connected with the coverall suits, increasing with distance. Wergard and Telzey joined him in apparent insubstantiality. They went around the embankment, came to the fence.

It was more than a fence.

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Closely spaced along the rails topping it, twenty feet above, were concealed pickup devices which registered within the house. The diagrams had listed and described them. Now reasonable caution and the equipment in the suits of the three trespassers should give the devices nothing to register.

They moved slowly along the fence, twelve feet apart, not speaking here though they carried distorters which smothered voice tones within the distance of a few feet, until Wergard, in the lead, reached a closed gate where the road they'd been following turned through the fence. His wavering contours stopped there; and Telzey and Dasinger also stopped where they were. Wergard was the burglary expert; his job was now to get them through the gate. It was locked, of course. The relays which opened the lock were in the house, and the lock itself was a death trap for anyone attempting to tamper with it. However, nobody had seemed concerned about those details, and Telzey decided not to worry either. Wergard was doing something, but she couldn't determine what. His foggy shape blurred out a quarter of the gate. Which wasn't bothering Wergard; the effect wasn't a subjective one. Telzey could see a faint haze about herself, which moved as she did. But it didn't interfere with her vision or blur her view of herself. She looked over at the house, still more than half hidden here by intervening trees.

It was a large windowless structure. A pale glow bathed the lower section of the front wall. That came from a lit area they'd have to cross. Closer to them, on this side of the trees, the ground was shadowy, heavily dotted with sizable shrubs, through which she could make out the outlines of a high hedge. This was where the Brisell pack prowled. She thought she could distinguish something moving slowly on the ground between two shrubs. It might be one of the dogs. Otherwise there was no sign of them.

A voice suddenly said something.

Telzey didn't move. She hadn't heard those words through her ears but through the ears of her contact. He was replying now, the sound of his own voice less distinct, a heavy rumble. She blinked, pushing probes out quickly into newly accessible mind areas, orienting herself. The contact was opening up nicely.

A hand tapped her shoulder. She looked up at Dasinger beside her. He indicated the gate, where Wergard had stepped back and stood waiting for them. The gate was open.

The thing she'd thought she'd seen moving occasionally on the ground between two shrub clusters was one of the Brisells. He was ly-

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ing on his side as they came up, and, except for jerking his hind legs slightly, he wasn't moving just then. Two other dogs, not far from him, had been out of sight behind the shrubs. One turned in slow circles, with short, staggering steps. The other sat with drooping head, tongue lolling far down, shaking himself every few seconds. They were powerful animals with thick necks, huge heads and jaws, torsos protected by flexible corselets. None of them paid the slightest attention to the human ghost shapes.

Dasinger beckoned Telzey and Wergard to him, said softly, "They'll be no good for an hour or two. But we don't know that our business here will be over in an hour or two. We'll get their handler in the shelter now. Then it should be worth a few minutes finding the rest of the pack and putting them out till tomorrow with stun charges."

Wergard nodded; and Dasinger said to Telzey, "Stay here near those three so we don't lose you."

"All right."

She watched them hold their guns briefly to the heads of the dogs. Then the blurred shapes moved soundlessly off, becoming more apparitional with each step. In moments, she couldn't see them at all. The dogs lay unmoving now; and nothing else stirred nearby. She went back to her contact. Human thought whispers which came from other minds were reaching her from time to time, but she didn't try to develop those touches. The man she'd started working on was in charge of the Colmer Agency group and stationed near the entry of the house, directly beyond the lit area. She should get the best results here by concentrating attention on him.

His superficial thoughts could be picked up readily by now. It was the thinking of a bored, not very intelligent man, but a dangerous and well-trained one—a human Brisell. He and his group were in the second hour of an eight-hour stint of guard duty. He was looking forward to being relieved. Telzey gave the vague flow of thoughts prods here and there, turning them into new directions. She got a self-identification: his name was Sommard. He and the other Colmer guards knew nothing of what went on inside the house, and weren't interested.

On arrival, they'd been admonished to constant alertness by a Mr. Costian. Sommard figured Mr. Costian for a nervous nut; the place obviously was well protected without them. But that wasn't his business, and he was doing his duty, however perfunctorily. His attention never wandered far. Two other guards stood to his right and left some fifty yards away, at the corners of the house. The remaining two were at the rear of the

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building where there was a service entry. That checked with what the Kyth agency had established about the defense arrangements.

There was a sudden wash of mental brightness. It steadied, and Telzey was looking out of Sommard's eyes into the wide illuminated court below the house where the estate road terminated. Keeping watch on that open area, up to the fence on the far side and the locked road gate in the fence, was his immediate responsibility. If anyone not previously authorized by Mr. Costian to be there appeared in the court, there'd be no challenge. He'd give his companions and the people in the house a silent alert, and shoot the intruder. Of course, no one would appear there! He yawned.

Telzey let the view of the court go, made some preparations, reduced contact and glanced at her watch. It has been four and a half minutes since the Kyth men left her. She began looking about for them, presently saw a haziness some twenty feet away, condensing slightly and separating into two shapes as it drew closer. A genuine pair of ghosts couldn't have moved more quietly. "The section's taken care of," Dasinger was saying then. "Anything to report?"

Telzey told them what she'd learned. Dasinger nodded. "Costian's been Larien Selk's underworld contact on Orado. It's probable that the pros delivered Noal to him." He scratched his chin. "Now what's the best way to take the agency guards out gently? We have no dispute with Colmer."

Wergard said, "Going through the gate's still possible, but it'll call for fast moving once we're through or we'd risk a disturbance. The long way around past the cliffs seems safer to me."

Telzey shook her head.

"That won't be necessary," she said.

Sommard presently shut his eyes for no particular reason except that he felt like it. The road gate across the court opened slightly, stayed open a few seconds, closed quietly again. Sommard then roused himself, looked briskly about. He glanced at his two colleagues, stationed at the corners of the house on either side of him. They stood unmoving, as bored as he was. All was well. He scratched his chest, yawned again.

Thirty feet from him, invisible as far as he was concerned, Telzey settled herself on the low balustrade above the court, looked at him, reached back into his mind. She waited. Something like a minute passed. The guard at the house corner to Sommard's left took two stumbling steps to the side and fell backward.

Sommard's awareness blanked out in the same instant. His knees buckled: he slid down along the

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wall against which he had been leaning, went over on his side and lay still.

Telzey looked around at the guard at the other house corner. He was down and out, too, and Wergard and Dasinger were now on their way along the sides of the house to take care of the two guards at the rear. She stood up and went over to Sommard. What she'd done to him was a little more complicated than using a stun gun, a good deal gentler than a stun gun's jolt. The overall effect, however, was the same. He'd go on sleeping quietly till morning.

She stayed beside him to make it easier for Dasinger to find her when he came to take her to the back of the house. There was an entry there which led to the servants' quarters below ground level. They would use that way to get into the house. There should be only three men in the servants' quarters tonight—Larien Selk's second gate guard team. They might be asleep at present. The estate's normal staff had been transferred to other properties during the past week. In the upper house were Costian, Larien Selk, probably Noal Selk, and two technicians who kept alternate watch on the instruments of the protective system. That was all.

Getting into the house wasn't likely to be much of a problem now. But the night's work might have only begun.

IV

"I'm getting traces of Larien," Telzey said.

"And Noal?" Dasinger asked.

"I'm not sure. There was something for a moment . . . but—" Her voice trailed off unsteadily.

"Take your time." Dasinger, leaning against a table ten feet away, watching her in the dim glow of a ceiling light, had spoken quietly. They'd turned off the visual distorters; the ghost haze brought few advantages indoors. Wergard had found the three off-duty gate guards asleep, left them sleeping more soundly. He'd gone off again about some other matter. Telzey and Dasinger were to stay on the underground level until she'd made her contacts, established what the situation here was.

She leaned back in her chair, closed her eyes, sighed. There was silence then. Dasinger didn't stir. Telzey's face was pale, intent. After a while, her breathing grew ragged. Her lips twisted slowly. It might have been a laborious mouthing of words heard in her mind. Her fingers plucked fitfully at the material of the coveralls. Then she grew quiet. Wergard returned soundlessly, remained standing outside the door.

Telzey opened her eyes, looked at Dasinger and away from him, straightened up in the chair, and passed her tongue over her lips.

"It's no use," she said flatly.

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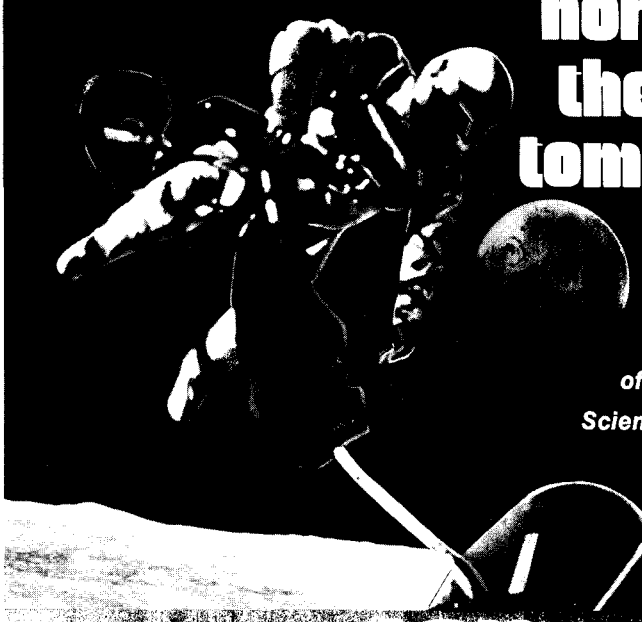

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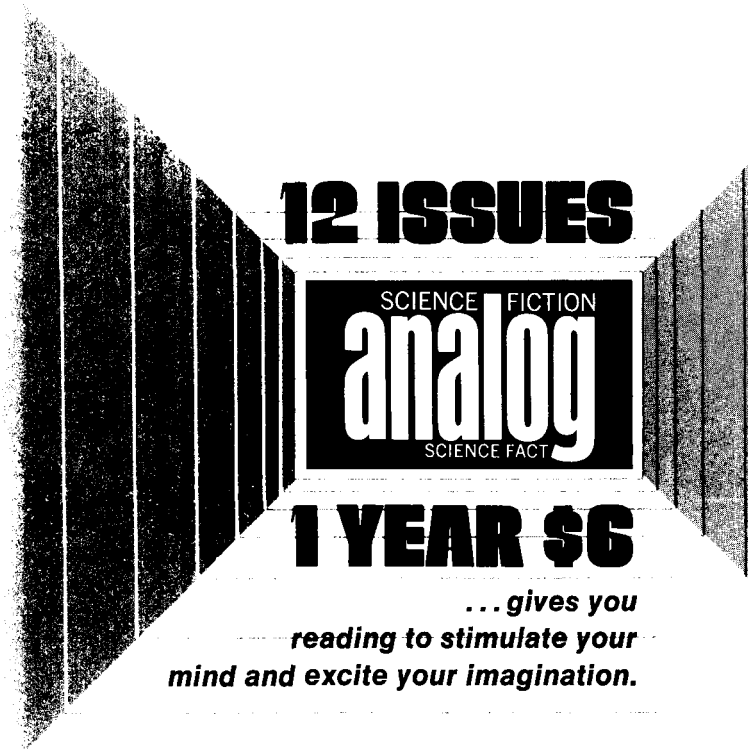

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"You couldn't contact Noal?"

She shook her head. "Perhaps I could. I don't know. You'll have to get the psi block shut off, and I'll try. He's not in the house." She began crying suddenly, stopped as suddenly. A valve had opened; had been twisted shut. "But we can't help him," she said. "He's dying."

"Where is he?"

"In the sea."

"In the sea? Go ahead."

She shrugged. "That's it! In the sea, more or less east of Joca Village. It might be a hundred miles from here, or two thousand. I don't know; nobody knows. Larien didn't want anybody to know, not even himself."

Wergard had come into the room. She looked over at him, back at Dasinger. "It's a bubble for deep-water work. Something the Selks made on Cobril. Marine equipment. Larien had it brought in from Cobril. This one has no operating controls. It was just dropped off, somewhere."

An automated carrier had been dispatched, set on random course. For eight hours it moved about the sea east of the mainland; then it disintegrated and sank. At some randomly selected moment during those eight hours, relays had closed, and the bubble containing Noal Selk began drifting down through the sea.

She told them that.

Dasinger said, "You said he's dying . . ."

She nodded. "He's being eaten. Some organism—it tries to keep the animals it feeds on alive as long as it can. It's very careful . . . I don't know what it is."

"I know what it is," Dasinger said. "When was it injected?"

"Two days ago."

Dasinger looked at Wergard. Wergard shrugged, said, "You might find something still clinically alive in the bubble five days from now. If you want to save Noal Selk, you'd better do it in hours."

"It's worth trying!" Dasinger turned to Telzey. "Telzey, what arrangements has Larien made in case the thing got away from him?"

"It isn't getting away from him," she said. "The bubble's got nondetectable coating. And if somebody tried to open it, it would blow up. There's a switch in the house that will blow it up any time. Larien's sitting two feet from the switch right now. But he can't touch it."

"Why not?" Wergard asked.

Telzey glanced at him. "He can't move. He can't even think. Not till I let him again."

Dasinger said, "The destruct switch isn't good enough. Isn't there something else in the house, something material, we can use immediately as evidence of criminal purpose?"

Telzey's eyes widened. "Evidence?" For a moment, she seemed about to laugh. "Goodness, yes, Dasinger! There's all the evidence

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in the world. He's got Noal on screen, two-way contact. He was talking to Noal when I started to pick him up. That's why—"

"Anyone besides Costian and the two techs around?" Dasinger asked Wergard.

"No."

"Put them away somewhere," Dasinger said. "Telzey and I will be with Larien Selk."

They weren't going to find the bubble. And if some accident had revealed its location, they wouldn't have got Noal Selk out of it alive.

They hadn't given up. Dasinger was speaking to the Kyth agency by pocket transmitter within a minute after he'd entered Larien's suite with Telzey, and the agency promptly unsheathed its claws. Operators, who'd come drifting into Joca Village during the evening, showing valid passes, converged at the entry to the Selk estate, set up some lethal equipment, and informed Village Security the section was sealed. Village Security took a long, thoughtful look at what confronted it in the gate road, and decided to wait for developments.

Dasinger remained busy with the transmitter, while Wergard recorded what Larien's two-way screen showed. Telzey, only half-following the talk, spoke only when Dasinger asked questions. She reported patiently then what he wanted to know, information she drew without much difficulty from Larien's paralyzed mind—the type of nondetectable material coating the deep-water device; who had applied it; the name of the Cobril firm which installed the detonating system. They were attacking the problem from every possible angle, getting the help of researchers from around the planet. On Cobril, there was related activity by now. Authorities who would be involved in a sea search here had been alerted, were prepared to act if called on. The Kyth agency had plenty of pull and was using it.

The fact remained that Larien Selk had considered the possibilities. It had taken careful investigation, but no special knowledge. He'd wanted a nondetectable coating material and a tamperproof self-destruct system for his deep-water device. Both were available; and that was that. Larien had accomplished his final purpose. The brother who'd cheated him out of his birthright, for whom he'd been left in a vault, ignored, forgotten, incomplete, had been detached from humanity and enclosed in another vault where he was now being reduced piecemeal, and from which he would never emerge. As the minutes passed, it became increasingly clear that what Dasinger needed to change the situation was an on-the-spot scientific miracle. Nothing suggested there were miracles forthcoming. Lacking that, they could

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watch Noal Selk die, or, if they chose, speed his death.

Telzey bit at her lip, gaze fastened on Larien who lay on a couch a dozen feet from her. They'd secured his hands behind his back, which wasn't necessary; she'd left her controls on him, and he was caught in unawareness which would end when she let it end. That strong, vital organism was helpless now, along with the mind that had wasted itself in calculating hatred for so many years.

There was something here she hadn't wanted to see . . .

A psi mentality needed strong shutoffs. It had them, developed them quickly, or collapsed into incoherence. The flow of energies which reached nonpsis in insignificant tricklings, must be channeled, directed, employed—or sealed away.

Shutoffs were necessary. But they could be misapplied. Too easily, too thoroughly, by a mind that had learned to make purposeful use of them.

There was something she'd blocked out of awareness not long ago. For a while, she'd succeeded in forgetting she'd done it. She knew now that she had done it, but it was difficult to hold her attention on the fact. Her mind drew back from such thoughts, kept sliding away, trying to distract itself, trying to blur the act in renewed forgetfulness.

She didn't want to find out what it was she'd shut away. By that, she knew it was no small matter. There was fear involved.

Of what was she afraid?

She glanced uneasily over at the screen showing the brightly lit metallic interior of the bubble. Wergard stood before it, working occasionally at his recordings. She hadn't looked at the screen for more than a few seconds since coming into the room. It could be turned to a dozen views, showing the same object from different angles and distances.

The object was a human body which wasn't quite paralyzed because it sometimes stirred jerkily, and its head moved. The eyes were sometimes open, sometimes shut. It looked unevenly shrunken, partly defleshed by what seemed a random process, skin lying loosely on bone here and there, inches from the swell of muscle. However, the process wasn't a random one; the alien organism within the body patched up systematically behind itself as it made its selective harvest. Outside tubes were attached to the host. The body wouldn't die of dehydration, or starvation; it was being nourished. It would die when not enough of it was left to bind life to itself, or earlier if the feeding organism misjudged what it was doing. Dasinger had said its instincts were less reliable with humans because they weren't among its natural food animals.

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Or Noal Selk would die when it was decided he couldn't be saved, and somebody's hand reached for the destruct switch.

In any case, he would die. What the screen showed were the beginnings of his death, whatever turn it took in the end. There was no reason for her to watch that. Noal, lost in the dark sea, in his small bright-lit tomb unknown miles from here, was beyond her help.

Her eyes shifted back to Larien. It happened, she decided, at some point after she'd moved into his mind, discovered what he had done, and, shocked, was casting about for further information, for ways to undo this atrocity. Almost now, but not quite, she could remember the line of reflections she'd followed, increasingly disturbed reflections they seemed to be. Then—then she'd been past that point. Something flashed up, some horrid awareness; instantly she'd buried it, sealed it away, sealed away that entire area of recall.

She shook her head slightly. It remained buried! She remembered doing it now, and she wouldn't forget that again. But she didn't remember what she had buried, or why. Perhaps if she began searching in Larien Selk's mind . . .

At the screen, Wergard exclaimed something. Telzey looked up quickly. Dasinger had turned away from the table where he'd been sitting, was starting toward the screen.

Sounds began to come from the screen. She felt the blood drain from her face.

Something was howling in her mind—wordless expression of a terrible need. It went on for seconds, weakened abruptly and was gone. Other things remained.

She stood up, walked unsteadily to the screen. The two men glanced around as she came up. An enlarged view of Noal Selk's head filled the screen. There were indications that the feeder had been selectively at work here, too; but there wasn't much change in the features. The eyes were wide open, staring up past the pickup. The mouth was lax and trembling; only wet, shaky breathing sounds came from it now.

Wergard said, "For some moments, he seemed fully conscious. He seemed to see us. He . . . well, the speaking apparatus isn't essential to life, of course. Most of that may be gone. But I think he was trying to speak to us."

Telzey, standing between them, looking at the screen, said, "He saw you. He was trying to ask you to kill him. Larien let him know it could be done any time."

Dasinger said carefully, "You *know* he was trying to ask us to kill him?"

"Yes, I know," Telzey said. "Be quiet, Dasinger. I have to think now."

She blinked slowly at the screen.

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Her diaphragm made a sudden, violent contraction as a pain surge reached her. Pain shutoff went on; the feeling dimmed. Full contact here . . .

Her mouth twisted. She hadn't wanted it! Not after what she'd learned. That was what she hadn't allowed to come into consciousness. She'd told herself it wasn't possible to reach Noal where he was, even after they'd shut off the psi block in the walls of the house. She'd convinced herself it was impossible. But she'd made the contact, and it had developed, perhaps as much through Noal's frenzied need as through anything she'd done; and now she'd been blazingly close to his mind and body torment—

She brushed her hand slowly over her forehead. She felt clammy with sweat.

"Telzey, is something wrong with you?" Dasinger asked.

She looked up at their watchful faces.

"No, not really. Dasinger, you know you can't save him, don't you?"

His expression didn't change. "I suppose I do," he acknowledged. "I suppose we all do. But we'll have to go on trying for a while, before we simply put him to death."

She nodded, eyes absent. "There's something I can try," she told them. "I didn't think of it before."

"Something *you* can try?" Wergard said, astonished, uneasily. His head indicated the screen. "To save him *there?*"

"Yes. Perhaps."

Dasinger cleared his throat. "I don't see . . . what do you have in mind?"

She shook her head. "I can't explain that. It's psi. I'll try to explain as I go along, but I probably won't be able to explain much. It may work, that's all. I've done something like it before."

"But you can't—" Wergard broke off, was silent.

Dasinger said, "You know what you're doing?"

"Yes, I know." Telzey looked up at them again. "You mustn't let anyone in here. There mustn't be any disturbance or interference, or everything might go wrong. And it will take time. I don't know how much time."

Neither of them said anything for some seconds. Then Dasinger nodded slowly.

"Whatever it is," he said, "you'll have all the time you need. Nobody will come in here. Nobody will be allowed on the estate before you've finished and give the word."

Telzey nodded. "Then this is what we'll have to do."

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She had done something like this, or nearly like this, before . . .

Here and there was a psi mind with whom one could exchange the

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ultimate compliment of using no mental safeguards, none whatever. It was with one of those rare, relaxing companions that she'd done almost what she'd be doing now. The notion had come up in the course of a psi practice session. One was in Orado City; one at the tip of the Southern Mainland, at the time. They'd got together at the thought level, and were trying out various things, improving techniques and methods.

"I'll lend you what *I* see if you'll lend me what *you* see," one of them had said.

That was easy enough. Each looked suddenly at what the other had looked at a moment ago. It wasn't the same as tapping the sensory impressions of a controlled mind. Small sections of individual awareness, of personality, appeared to have shifted from body to body.

It went on from there. Soon each was using the other's muscles, breathing with the other's lungs, speaking with the other's voice. They'd got caught up in it, and more subtle transfers continued in a swift double flow, unchecked: likes and dislikes, acquired knowledge, emotional patterns. Memories disintegrated here, built up there; vanished, were newly complete—and now quite different memories. Only the awareness of self remained—that probably couldn't be exchanged, or could it?

Then:

"Shall we?"

They'd hesitated, looking at each other, with a quarter of the globe between them, each seeing the other clearly, in their exchanged bodies, exchanged personalities. One threadlike link was left for each to sever, and each would become the other, with no connection then to what she had been.

"Of course, we can change right back—"

Yes, but could they? Could they? Something would be different, would have shifted; they would be in some other and unknown pattern—and suddenly, quickly, they were sliding past each other again, memories, senses, controls, personality particles, swirling by in a giddy two-way stream, reassembling, restoring themselves, each to what was truly hers. They were laughing, but a little breathlessly, really a little frightened now by what they'd almost done.

They'd never tried it again. They'd talked about it. They were almost certain it could be done, oh, quite safely! They'd be two telepaths still, two psis. It should be a perfectly simple matter to reverse the process at any time.

It should be. But even to those who were psis, and in psi, much more remained unknown about psi than was known. Anyone who gained any awareness at all understood there were limits beyond which one couldn't go, or didn't try to go. Limits beyond which things went oddly wrong.

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The question was whether they would have passed such a limit in detaching themselves from their personality, acquiring that of another. It remained unanswered.

What she had in mind now was less drastic in one respect, seemed more so in another. She would find out whether she could do it. She didn't know what the final result would be if she couldn't.

She dissolved her contact with Noal. It would be a distraction, and she could restore it later.

Larien Selk had been fastened securely to his couch. Dasinger and Wergard then fastened Telzey as securely to the armchair in which she sat. She'd told them there might be a good deal of commotion here presently, produced both by herself and by Larien. It would be a meaningless commotion, something to be ignored. They wouldn't know what they were doing. They had to be tied down so they wouldn't get hurt.

The two men asked no questions. She reached into a section of her brain, touched it with paralysis, slid to Larien Selk's mind. In his brain, too, a selected small section went numb. Then the controls she'd placed on him were flicked away.

He woke up. He had to be awake and aware for much of this, or her work would be immeasurably, perhaps impossibly, increased. But his wakefulness did result in considerable commotion, though much less than there would have been if Larien had been able to use his voice—or, by and by, Telzey's. She'd silenced both for the time being. He couldn't do more than go through the motions of screaming. Nor could he move around much, though he tried very hard.

For Larien, it was a terrifying situation. One moment, he'd been sitting before the screen, considering whether to nudge the console button which would cause a stimulant to be injected into Noal and bring him back to consciousness again for an hour or two. He enjoyed talking to Noal.

Then, with no discernible lapse in time, he sensed he was lying on his back, arms and legs stretched out, tied down. Simultaneously, however, he looked up from some point in midair at two tense-faced men who stood between him and the screen that peered into Noal's bubble.

Larien concluded he'd gone insane. In the next few minutes, he nearly did. Telzey was working rapidly. It wasn't nearly as easy work as it had been with a cooperating psi; but Larien lacked the understanding and ability to interfere with her, as a psi, who wasn't cooperating, would have done. There was, of course, no question of a complete personality exchange here. But point by point, sense by sense, function by function, she

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was detaching Larien from all conscious contacts with his body. His bewildered attempts to retain each contact brought him into a corresponding one with hers—and that particular exchange had been made.

The process was swift. It was Larien's body that struggled violently at first, tried to scream, strained against its fastenings. Telzey's remained almost quiescent. Then both twisted about. Then his, by degrees, relaxed. The other body continued to twist and tug, eyes staring, mouth working desperately.

Telzey surveyed what had been done, decided enough had been done at this level. Her personality, her consciousness, were grafted to the body of Larien Selk. His consciousness was grafted to her body. The unconscious flows had followed the conscious ones.

She sealed the access routes to memory storage in the Telzey brain. The mind retained memory without the body's help for a while. For how long a while was something she hadn't yet established.

Time for the next step. She withdrew her contact with Larien's mind, dissolved it. Then she cut her last mind links to her body. It vanished from her awareness. She lay in Larien Selk's body, breathing with its lungs. She cleared its throat, lifted the paralysis she'd placed on the use of its voice.

"Dasinger!" the voice said hoarsely. "Wergard!"

Footsteps came hurrying over.

"Yes, *he's* over *there*. I'm here . . . for now. I wanted you to understand so you wouldn't worry too much."

They didn't say anything, but their faces didn't look reassured. Telzey added, "I've got his . . . its voice cut off. Over there, I mean."

What else should she tell them? She couldn't think of anything; and she had a driving impatience now to get on with this horrid business, to get it done, if she could get it done. To be able to tell herself it was over.

"It'll be a while before I can talk to you again," Larien Selk's voice told Wergard and Dasinger.

Then they vanished from her sight. Larien's eyes—no longer in use—closed. Telzey had gone back to work. Clearing the traces of Larien's memories and reaction patterns from his brain took time because she was very thorough and careful about it. She wanted none of that left; neither did she want to damage the brain. The marks of occupancy faded gradually, cleaned out, erased, delicately annihilated; and presently she'd finished. She sent out a search thought then to recontact the mind of Noal Selk in the brightly lit hell of his bubble, picked up the pattern almost at once and moved over into his mind.

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He was unconscious, but something else here was conscious in a dim and limited way. Telzey turned her attention briefly to the organism which had been implanted in Noal. A psi creature, as she'd thought. The ability to differentiate so precisely between what was and was not immediately fatal to a creature not ordinarily its prey had implied the use of psi. The organism wasn't cruel; it had no concept of cruelty. It was making a thrifty use of the food supply available to it, following its life purpose.

She eased into the body awareness from which Noal had withdrawn, dimming the pain sensations which flared up in her. It was immediately obvious that very extensive damage had been done. But a kind of functional balance lingered in what was left. The body lived as a body.

And the mind still lived as a mind, sustaining itself by turning away from the terrible realities about it as often as Noal could escape from pain into unconsciousness. She considered that mind, shifting about it and through it, knowing she was confronting the difficulty she'd expected. Noal couldn't cling to this body; in intention, he already was detached from it. But that was the problem. He was trying, in effect, to become disembodied and remain that way.

He had a strong motivation. She should be able to modify it, nullify it eventually; but it seemed dangerous to tamper with Noal any more than she could help. There wasn't enough left of him, physically or mentally, for that. He had to want to attach himself fully and consciously to a body again, or this wasn't going to work. She could arouse him, bring him fully awake . . .

He would resist it, she thought.

But she might give him something he wouldn't resist.

Noal dreamed.

It was a relaxed dream, universes away from pain, fear, savage treachery. He remembered nothing of Larien. He was on Cobril, walking along with a firm, quick stride in warm sunlight. He was agreeably aware of the strength and health of his body.

Something tugged at him.

Vision blurred startingly. Sound faded. The knowledge came that the thing that tugged at him was trying to drag him wholly away from his senses, out of himself, into unfeeling nothingness.

Terrified, he fought to retain sight and sound, to cling to his body.

Telzey kept plucking him away, taking his place progressively in the still functional wreckage left by the organism, barring him more and more from it. But simultaneously she made corresponding physical anchorages available for him elsewhere; and Noal, still

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dreaming, not knowing the difference, clung to each point gained with frantic determination. She had all the cooperation she could use. The transfer seemed accomplished in moments.

She told him soothingly then to go on sleeping, go on dreaming pleasantly. Presently, agitations subsiding, he was doing it.

And Telzey opened Noal Selk's gummily inflamed and bloodshot eyes with difficulty, looked out into the metallic glittering of the bubble, closed the eyes again. She was very much here—too much so. Her pain shutoffs were operating as far as she could allow them to operate without hampering other activities, but it wasn't enough. A sudden fresh set of twinges gave her a thought then; and she put the busy psi organism to sleep. At least, that part of it shouldn't get any worse.

But she'd have to stay here a while. In this body's brain was the physical storehouse of Noal's memories, the basis of his personality. It was a vast mass of material; getting it all transferred in exact detail to the brain she'd cleared out to receive it was out of the question. It probably could be done, but it would take hours. She didn't have hours to spare.

The essentials, however, that which made Noal what he was, should be transplanted in exact detail. She started doing it. It wasn't difficult work. She'd doctored memories before this, and it was essentially the same process.

It was simply a question of how much she could get done before she had to stop. The physical discomforts that kept filtering into her awareness weren't too serious a distraction. But there was something else that frightened her—an occasional sense of vagueness about herself, a feeling as if she might be growing flimsy, shadowy. It always passed quickly, but it seemed a warning that too much time was passing, perhaps already had passed, since she'd cut herself off from her own brain and body and the physical basis of memory and personality.

She paused finally. It should do. It would have to do. Her mind could absorb the remaining pertinent contents of this body's brain in a few minutes, retain it until she had an opportunity to feed back to Noal whatever else he might need. It would be secondhand memory, neither exact nor complete. But he wouldn't be aware of the difference, and no one who had known him would be able to tell there was a difference. She couldn't risk further delay. There was a sense of something that had been in balance beginning to shift dangerously, though she didn't yet know what it was.

She began the absorption process. Completed it. Went drifting slowly off then through nothing, through nowhere . . . Peered out

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presently again through puzzled sore eyes into the gleaming of the bubble.

Hot terror jolted through her—

"Dasinger!"

Dasinger turned from the couch on which the Larien body lay, came quickly across the room. "Yes?"

Wergard indicated the other figure in the armchair.

"This one seems to be coming awake again!"

Dasinger looked at the figure. It was slumped back as far as the padded fastenings which held its arms clamped against the sides of the chair permitted. The head lolled to the left, eyes slitted, blood-smeared mouth half open. "What makes you think so?" he asked.

The figure's shoulders jerked briefly, almost as he spoke.

"That," Wergard said. "It's begun to stir."

They watched, but the figure remained quiet now. Wergard looked at the screen. "Some slight change there, too!" he remarked. "Its eyes were open for a while. A minute ago, they closed."

"Coinciding with the first indications of activity here?" Dasinger asked.

"Very nearly. What about the one on the couch?"

Dasinger shrugged. "Snoring! Seems to smile now and then. Nobody could be more obviously asleep."

Wergard said, after a moment, "So it must be between these two now?"

"If she's been doing what we think, it should be . . . There!"

The figure in the chair sucked in a hissing breath, head slamming up against the back rest. The neck arched, strained, tendons protruding like tight-drawn wires. Dasinger moved quickly. One hand clamped about the jaw; the other gripped the top of the skull. "Get something back in her mouth!"

Wergard already was there with a folded wet piece of cloth, wedged it in between bared teeth, jerked his fingers back with a grunt of pain. Dasinger moved his thumb up, holding the cloth in place. The figure was in spasmodic, violent motion now, dragging against the fastenings. Wergard placed his palms above its knees, pressed down hard, felt himself still being shifted about. He heard shuddering gasps, glanced up once and saw blue eyes glaring unfocused in the contorted face.

"Beginning to subside!" Dasinger said then.

Wergard didn't reply. The legs he was holding down had relaxed, gone limp, a moment before. Howling sounds came from the screen, turned into a strangled choking, went silent. He straightened, saw Dasinger take the cloth from Telzey's mouth. She looked at them in turn, moved her puffed lips, grimaced uncomfortably.

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"You put your teeth through your lower lip a while ago," Dasinger explained. He added, "That wasn't you, I suppose. You *are* back with us finally, aren't you?"

She was still breathing raggedly. She whispered, "Not quite . . . almost. Moments!"

Animal sounds blared from the screen again. Their heads turned toward it. Wergard went over, cut off the noise, looked at the twisting face that had belonged to Noal Selk. He came back then and helped Dasinger free Telzey from the chair. She sat up and touched her mouth tentatively, reminding Wergard of his bitten finger. He looked at it.

Telzey followed his glance. "Did I do that, too?"

"Somebody did," Wergard said shortly. He reached for one of the cloths they'd used to keep her mouth propped open, wrapped it around the double gash. "How do you feel, Telzey?"

She shifted her shoulders, moved her legs. "Sore," she said. "Very sore. But I don't seem to have pulled anything."

"You're back all the way?"

She drew a long breath. "Yes."

Wergard nodded. "Then let's get this straight. Over there on the couch, asleep—that's now Noal?"

"Yes," Telzey said. "I'll have to do a little more work on him because he doesn't have all his memory yet. But it's Noal—in everything that counts, anyway."

"He doesn't have all his memory yet," Wergard repeated. "But it's Noal!" He stared at her. "All right. And you're you again." He jerked his thumb at the screen. "So the one who's down in the bubble now is Larien Selk?"

She nodded.

"Well—" Wergard shrugged. "I was watching it," he said. He looked at Dasinger. "It happened, that's all!"

He went to the screen console, unlocked the destruct switch, and turned it over. The screen went blank.

The three of them remained silent for some seconds then, considering the same thought. Wergard finally voiced it. "This is going to take a remarkable amount of explaining!"

"I guess it will," Telzey said. "But we won't have to do it."

"Eh?" said Dasinger.

"I know some experts," she told him. She climbed stiffly out of the chair. "I'd better get to work on Noal now, so we'll have that out of the way."

The Operator on Duty at the Psychology Service Center in Orado City lifted his eyebrows when he saw Telzey walking toward his desk in the Entry Hall. They'd met before. He pretended not to notice her then until she stopped before the desk.

He looked up. "Oh, it's you," he said indifferently.

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"Yes," said Telzey. They regarded each other with marked lack of approval.

"Specifically," asked the Operator, "why are you here? I'll take it for granted it has to do with your general penchant for getting into trouble."

"I wouldn't call it that," Telzey said. "I may have broken a few Federation laws last night, but that's beside the point. I'm here to see Klayung. Where do I find him?"

The Operator on Duty leaned back in his chair and laced his fingers.

"Klayung's rather busy," he remarked. "In any case, before we bother him you might explain the matter of breaking a few Federation laws. We're not in that much of a hurry, are we?"

Telzey considered him reflectively.

"I've had a sort of rough night," she said then. "So, yes—we're in exactly that much of a hurry. Unless your shields are a good deal more solid now than they were last time."

His eyelids flickered. "You wouldn't be foolish enough to—"

"I'll count to two," Telzey said. "One."

Klayung presently laid her report sheets down again, sat scratching his chin. His old eyes were thoughtful. "Where is he at present?" he asked.

"Outside the Center, in a Kyth ambulance," Telzey told him. "We brought Hishee along, too. Asleep, of course."

Klayung nodded. "Yes, she should have almost equally careful treatment. This is a difficult case."

"You can handle it?" Telzey asked.

"Oh, yes, we can handle it. We'll handle everything. We'll have to now. This could have been a really terrible breach of secrecy, Telzey! We can't have miracles, you know!"

"Yes, I know," Telzey said. "Of course, the Kyth people are all right."

"Yes, they're all right. But otherwise—"

"Well, I know it's going to be a lot of trouble for you," she said. "And I'm sorry I caused it. But there really wasn't anything else I could do."

"No, it seems there really wasn't," Klayung agreed. "Nevertheless—well, that's something I wouldn't recommend you try very frequently!"

Telzey was silent a moment.

"I'm not sure I'd try it again for any reason," she admitted. "At the end there, I nearly didn't get back."

Klayung nodded. "There was a distinct possibility you wouldn't get back."

"Were you thinking of having Noal go on as Noal?" Telzey inquired.

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"That should be the simplest approach," Klayung said. "We'll see what the Make-up Department says. I doubt it would involve excessive structural modifications . . . You don't agree?"

Telzey said, "Oh, it would be simplest, all right. But—well, you see, Noal was just nothing physically. He's got a great body now. It would be a shame to turn him back to being a nothing again."

Klayung looked at her a moment.

"Those two have had a very bad time," Telzey continued. "Due to Larien. It seems sort of fair, doesn't it?"

"If he's to become Larien Selk officially," Klayung remarked, "there'll be a great many more complications to straighten out."

"Yes, I realize that," Telzey said.

"Besides," Klayung went on, "neither Noal nor Hishee might want him to look in the least like Larien."

"Well, they wouldn't now, of course," Telzey agreed. "But after your therapists have cleared up all the bad things Larien's done to them, it might be a different matter."

Klayung's sigh was almost imperceptible. "All right. Supposing we get the emotional and mental difficulties resolved first, and then let the principals decide for themselves in what guise Noal is to resume his existence. Would that be satisfactory?"

Telzey smiled. "Thanks, Klayung!" she said. "Yes, very satisfactory!" ■

IN TIMES TO COME Next issue we begin Hal Clement's new novel, "Star Light." It's long—four parts. But it is, in a sense, a continuation of another long—and now classic!—Hal Clement novel, "Mission of Gravity."

In that the hero, the centipedish Barlennan, half pirate and half trader on his own weird world of Mesklin, journeyed from the equator, where gravity was a mere three times Earth's, to the south pole, where Mesklin's terrible 650-gravity pull had trapped a research rocket that men had sent in.

No entities, other than the Mesklinites, in the known Universe could exist in that gravity—let alone work and move actively!

It was inevitable that men would run up against other places that demanded study, but under conditions nothing remotely human could withstand. And Dhrawn was such a place. Bigger than Jupiter, warmer than the feeble little star it circled could account for, with a solid surface . . . was it a cold star or a self-heated planet or . . . well, *what?*

The fact it had a dense atmosphere, and a surface gravity forty times Earth's, made exploration obviously impossible. Unless . . . they got help from people to whom that was a "one tenth normal" gravity. Mesklinites!

But Mesklinites like Barlennan were traders, and had plans of their own . . .

THE EDITOR

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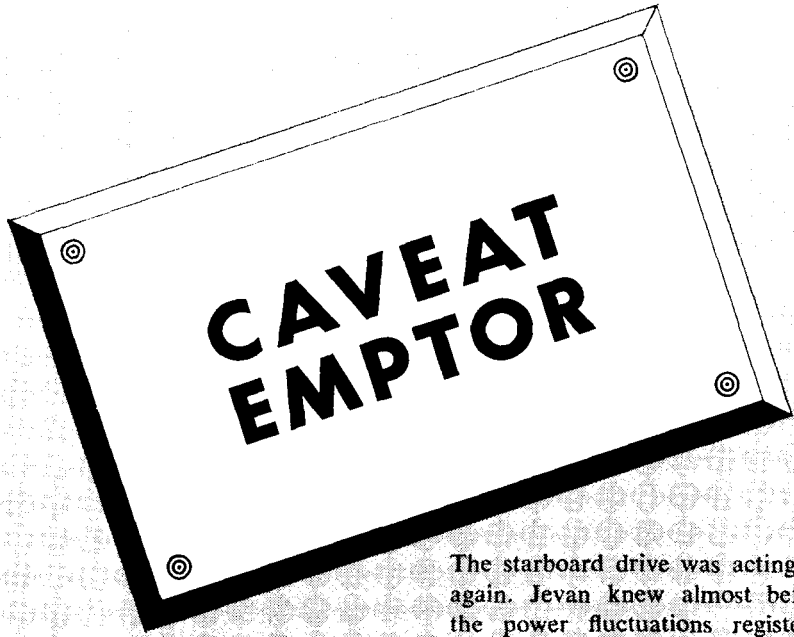

The essence of fair trade is that each party get honest value equal to what he sells.

LEE KILLOUGH

Illustrated by Vincent diFate

The starboard drive was acting up again. Jevan knew almost before the power fluctuations registered on the operations panel. Whether by vibrations, a subtle change in the ship's background noises, or telepathy the captain never bothered to determine. He had cursed and coaxed the *Varuna* across the Commonwealth so many times, from Andvari itself to the farthest colonies, that the trader's circuitry seemed almost an extension of Jevan's own nervous system. Sighing, he flipped a switch among many on the withers-high column at his side.

"Taalis . . ."

"I'm working on it," his chief engineer's voice snapped back at him.

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"I know you are," Jevan soothed. "Just keep her running until the rendezvous and I'll see that you get new drives."

"Providing the aliens buy," Taalis replied. "But I'll try to get her there . . . if I have to carry her on my back. I want their techs and all that lovely advanced technology to have another crack at this bolt bucket."

"Whisper when you say that," the captain warned. "If she hears you call her that, she'll quit cold."

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Switching out, he pivoted on his hindquarters for a sweeping survey of the controls. The tall, upright panels alternated with deck-to-overhead viewscreens around the circumference of the circular bridge. Aside from the column with the command controls, the center was empty. Necessarily. The centaurian bodies of the Andvarians needed maneuvering room.

The captain's dark eyes skimmed the rows of glowing lights and metered dials. Close-coupled but ex-

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tremely limber, he stood just short of two meters in height, copper-colored hair covering all his body but face and hands. His copper mane, clipped in a neat fringe along his torso, fell somewhat longer in front of his large ears and across his wide forehead. A broad, flattened nose with flaring nostrils gave him a somewhat pugnacious look.

"Jevan . . . drive pattern on the sensors."

The captain glanced at the long-maned blood bay by the scanning panel. "Our trader, possibly. Open communications with them, Ilith."

His first officer nodded, her tail swishing absently, and reached for the panel adjacent to the scanners.

"Reduce speed to hyper one," he ordered the weedy helmsman. Flipping a switch on the command column, he said, "Danae, report to the bridge. Danae!" There was no response. "Has anyone seen our guest?"

"She's in the lounge," someone replied.

Jevan clicked the switch. "Lounge. Lounge . . . is Danae up there?" He frowned. "The intercom there must be out again. Ilith, tell Engineering, and take command for a few minutes."

"Right," she replied without looking away from the communications panel.

On his way past, he gave her tail a playful tug. Agilely dodging the kick she aimed at him, he murmured, "Such a temper," and bolted from the bridge before she could try again, thick rubberoid matting on the deck absorbing the sound of his hooves.

Ilith grinned wickedly and shifted her full attention back to her panels.

Jevan took a ramp up to the domed lounge above the bridge. He paused in the doorway, eyes sweeping the room. Off-duty crew members were scattered among the tables, some playing games, others reading at tape viewers. One female played a flute softly. The alien was there, too . . . cross-legged on a table, playing Sei-tau with the ship's little gray supercargo. If the sharp, agitated motion of Birn's tail were any indication, the girl was winning.

The Andvarian studied her for a minute, still a little surprised that a being so thin and fragile, nothing more than a will-o'-the-wisp, could actually be a dominant species in her section of the galaxy . . . only bipedal, and her pale skin relatively hairless at that. She had to wear an artificial covering called a jumpsuit and special protection on her feet.

Looking up, she saw him. She smiled. "Captain, good morning," she greeted in accented but passable Andvarian.

"Likewise," he replied, joining them.

Birn only grunted, scowling

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down at the board. With a sigh he pushed it aside. "I concede defeat."

"We're in sensor range of your ship, Danae."

Conflicting emotions crossed her thin face. "Oh," she said at last.

The supercargo cocked his head quizzically. "You don't sound too pleased. Won't you be glad to go home?"

"I don't know." Her silver eyes laughed. "Chairs are going to seem prosaic after table-sitting. I've enjoyed these past weeks immensely." She looked up at Jevan. "Thank you for your hospitality."

"Your presence was necessary," the captain said. "We brought you along to learn our language while we picked up a cargo. How else could we arrange for an interpreter at our meet with your trade company?"

"This trip has been more than a linguistic challenge, though. It's been . . ." She paused, searching for words—tried another approach. "This is the primary contact between our races. Everything about you is new and yet to be learned . . . how you think, the way you live, your quirks, music, customs. We may not meet an entirely new race again in my lifetime and I'm lucky enough to be in on it. And what's more, I find I like your people very—"

She broke off, suddenly drowned out by angry shouting. Near them, two Andvarians reared and kicked at each other.

Jevan gauged the intensity of the quarrel with an experienced eye and roared, "Darl . . . Cal'lin, damp it before I hamstring both of you!"

As reinforcement, he picked up a Sei-tau piece and threw it. The heavy pyramid bounced off the back of one crewman's head. The two looked around, glared, and subsided, muttering. One delivered a last half-hearted kick at the other and stamped out of the lounge. Jevan watched until the remaining combatant had righted the table.

"Your methods of discipline are unique, Captain," Danae remarked.

Jevan came back dryly, "If I tried running the *Varuna* like a military ship, the crew would desert at the next port."

"I'm not criticizing," the linguist protested hurriedly. Sliding off the table she started for the ramp, walking between Birn and Jevan. "Free traders aren't beings who tolerate regimentation."

Jevan's mouth quirked. "We're rebels and misfits, you mean."

She looked up. "Individualists . . . free beings . . . free to dream, to hunt new worlds and chase ghost gold. I envy you."

"Yet you work for a trade giant like Galiol."

"There's no ghost gold left in the Federation. Only companies like Galiol make the fortunes." Something flickered across her face, too fast to be deciphered. "Captain . . ."

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"Yes?" Captain Jevan prompted.

"About Galiol. He'll . . ." Her voice trailed off. Jevan waited for her to go on but she shook her head. "Nothing."

"Pardon me." He reached for the nearest intercom unit and flipped the switch. "Taalis."

The engineer's voice came back after a short delay. "Speaking."

"How is the starboard drive?"

"She's fine now."

"Kiss her for me."

The engineer grunted and switched out.

Birn grimaced. "That drive . . . we live in terror of its moods."

"Without 'that drive,'" Jevan pointed out, "we would never have met Danae's civilization."

"Give credit to the navigational malfunction, too," the gray said.

The one had taken them off-course, out of the Commonwealth, and the other brought them to a dead stop in alien space. They could have limped home, eventually, on one drive, but before they had to try they were intercepted . . . by a Galiol pilot checking out a new yacht for his employer. He had lost no time calling in his discovery. Galiol, in turn, immediately dispatched a linguist and his best technicians to repair the Andvarians' ship and arrange a trade meet.

"Birn," Jevan said abruptly, "make sure everything is ready in the hold. Danae . . ." He jerked his head toward amidships.

As Jevan came on the bridge with the linguist, Ilith gestured toward the operations panel. "The tantrum's over."

He nodded. "Did you contact the trader?"

"Yes. Estimated time of rendezvous is now"—she checked the chronometer—"ten minutes."

Jevan sighed deeply and watched the scanning panel, where the drive pattern was becoming steadily stronger. "Ghost gold," he murmured. "Sometimes you catch it."

"If," Ilith said.

His tail switched. "If," he agreed. "If our cargo strikes Galiol's fancy."

Their eyes met. The selection of goods in the hold had not been picked at random. All Jevan's skill and experience had gone into the buying. They had subtly pumped the linguist to learn the likes and dislikes of the Federation population, seen to it she handled what merchandise already happened to be in the hold, observing her reactions closely. Then the captain and first officer had spent sleepless nights making up lists, debating, comparing, evaluating, sometimes arguing . . . only to discard everything and start over. The final choices reflected what Jevan thought would appeal most to the advanced, sophisticated races making up the Federation.

"If we've guessed wrong?" Ilith asked, following his line of thought flawlessly.

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He grinned. "Well . . . we can always turn pirate." He slapped her on the rump. "Back to your communicator, Number One. We're there."

The Galiol trader loomed on a viewscreen, almost filling it, a huge globe-shaped vessel carrying a spiral insignia above its registration numbers. Occasional weapons turrets gave the surface a blistered appearance. Thinking of his own meager armament, Jevan lifted appreciative brows.

Ilith's fingers played across the communications panel. "*Varuna* to Galiol trader."

"Galiol trader *Hlynn* here."

"Stand by to join locks." Her Galactic was halting, her accent thick, but, hopefully, understandable.

Apparently so. The other ship replied, "Standing by."

Jevan rattled orders. Carefully, the two ships maneuvered until the *Varuna's* main lock was in apposition to the *Hlynn's*. A short, accordion tunnel reached out from the globe, snapping into place around the *Varuna's* hatch. Moments later the big trader reported, "Testing for seal. Tunnel sealed."

Another voice, deep and preemptory, boomed, "Danae."

The linguist straightened. "Danae here, sir."

The voice spoke too rapidly for Jevan, with his limited knowledge of the language, to follow.

"Mr. Galiol says he wishes to hold the meeting aboard this ship," the girl explained.

"That's agreeable."

She repeated his answer to Galiol. The alien's voice boomed back.

"He's coming aboard with two staff members," Danae translated.

"Stand by the hatch to receive the boarding party," Jevan ordered. "Danae, we'll meet them. Ilith—"

She met his eyes and nodded. "I'll see you in the hold."

Jevan left for the main lock with the linguist. The alient girl walked fast, lengthening her stride to stay with him. Her face was expressionless but something in the angle of her shoulders and neck disturbed him.

"Is something wrong?" he asked.

She glanced up and looked away again. "No . . ." But just before they reached the hatch, she changed her mind. "Yes." Stopping short, she tilted back her chin to stare squarely at him. "Sometimes I don't care much for my job. In a few minutes you're going to be negotiating with Mr. Galiol and I'll be working for him, but before that happens, I think I should warn you. Edra Galiol took over a bankrupt company thirty years ago and made it the most powerful in the Federation, rivaled only by Karfan Trade."

Jevan's tail switched. "You make him sound ominous."

"He's . . . clever. Be careful."

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The silver eyes looked earnestly up at him. Jevan touched her shoulder. "Thank you." He prodded her into motion again. "I'll remember what you said."

"He'll try to take advantage of you."

He smiled. "I'll try not to let him."

They came around the corner just as a green light blinked on the lock controls.

"Outer door opening," the crewman at the panel reported. He watched his indicators. When the light went red, he pulled a lever. A second green light flashed and the hatch slid open with a soft hiss of pneumatics.

Jevan looked with interest at the three beings who stepped through. Like the linguist, they were bipeds, walking upright, each with two arms and a rounded head . . . but there the likeness ended. Each was a different species. The foremost was shorter than the Andvarians but no less muscular, his hair as copper as Jevan's own.

"Captain Jevan?" the man asked. "I'm Edra Galiol."

Jevan marshaled his vocabulary. "Welcome aboard, sir."

Galiol's heavy brows rose. "Danae taught you Galactic?" His eyes went past the captain to the wraith-like girl.

"Very little. Your staff?" Jevan asked, gesturing toward the two men behind the trader.

Galiol looked sharply at Danae.

"He says it will be faster and easier if you speak your own language and let me translate."

"Very well."

The girl bit her lip.

"Dar Zaal of my legal department," the trader said, introducing a thin, yellow-skinned reptilian being, who stared back out of slit-pupiled yellow eyes. "And Casus, my merchandising consultant."

Casus moved sinuously, nodding to the Andvarian. A masklike area on his face, Jevan noticed, was more darkly pigmented than the tawny skin around it, as was the skin of his hands.

"Captain," Galiol went on, "I cannot express my pleasure at this opportunity. New races mean an influx of new goods on the Galactic market and I have clients who pay well for new products. I hope the twist of fate that brought us together will also bring mutual profit."

"Yes," Jevan agreed simply, waving away a translation. He had caught the general meaning.

"How much profit depends, of course, on what you have to sell," *Galiol added.* "*And I can't very* well judge until I see your cargo. If you'll show us to the hold, Captain, we can begin."

The Andvarian understood that clearly enough. "This way," he said in Galactic.

Wheeling, he led the way toward the nearest ramp and down to the

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hold level. Galiol and the linguist trotted effortlessly behind. Coming off the ramp, they turned down one of the corridors which divided the hold into wedge-shaped sections.

"To save time and trouble," Jevan told the trader, "I've put samples of each item together in one hold. The other holds contain the same things, only in quantity."

Galiol lifted an inquiring brow at Danae, who obligingly interpreted. He nodded in approval.

The captain stopped at a broad doorway. It slid open, admitting them to a cavernous room stacked to the overhead light panels with bales, barrels, and plastic crates. A space had been cleared in the center and lamps set around the edge, making it a bright pool against which the rest of the hold seemed dim and shadowed by comparison. The air hung heavy with an exotic mixture of scents . . . to the four bipeds, alien scents, emanating from sources they could only guess at.

Ilith and Birn looked up from manhandling a huge crate into the central space, their eyes shining green with reflected light.

"Everything's ready," the first officer said.

Jevan's tail flicked. "Good. Gentlemen, Danae tells me that your people use 'chairs.' I am unfamiliar with them and have none aboard, so please feel free to . . . 'sit' on the crates."

His careful enunciation of the alien words made the linguist smile. Voice warm with suppressed laughter, she translated.

The lawyer promptly dropped onto a handy bale and leaned back against the pile of crates behind him, crossing his legs, legal case lying in his lap. Galiol, however, merely nodded and headed toward the crate Birn was standing on end.

"And these gentlemen are . . .?" he asked, glancing from the gray to Ilith.

The female's eyes rolled, white-rimmed, as Danae translated, and her tail switched irritably.

Grinning, Jevan answered, "My first officer, Miss Ilith, and Supercargo Birn."

Galiol muttered something Danae did not offer to translate, then said, "My apologies, First Officer. Captain, what are you going to show me first?"

For answer, Jevan broke the seal on the end of the crate and slid the lid open. Reaching in, he pulled out an armload of furs, and spread them across a crate where the light fell full on them. They were soft and thick, dark yet opalescent. The surface shimmered, subtly changing as the light struck them from a different angle.

The trader and his merchandising consultant picked up several, each a half meter or so square . . . blew on them, ran their fingers through the glossy pile. Danae had not seen any of this cargo and

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now her eyes widened. She picked up a pelt and stroked it, her expression rapt.

Galiol glanced at her and pursed his lips. "Name?"

Danae pulled her attention back to her job long enough to translate.

"We call them corona furs."

"Hm-m-m," Galiol grunted. His eyes slid over the Andvarians' sleek hides. "You wear them?"

"We have colonies on cold worlds and cities in the Pole regions of Andvari. Sometimes even our winter coats aren't sufficient. Then, of course, there is always female vanity."

Galiol's mouth quirked in a dry smile. "Continue, Captain."

While Ilith folded the pelts and repacked them, persuading a reluctant Danae to surrender the one she held, Birn dragged out a long bale.

"A sample of the fabrics manufactured in the Commonwealth," Jevan told the trader. As Galiol lifted brows, he added, "Capes are considered fashionable these days. Birn."

The gray broke open the bale and shook it. Bolts of material went rolling across the deck, spreading a lake of color and texture at the bipeds' feet—frothy waves as diaphanous as cobwebs, sleek and shining silks, heavy folds of rich velvetlike fabric, glittering metallics.

Someone in the group sighed and the reptilian lawyer leaned forward interestedly. Galiol shot a quick look at his people and waded forward through the fabrics. Slowly and silently, he felt them, held them to the light, inspected the weave. The feline consultant followed him, taking each sample as his superior finished with it. When they had looked at each, they held a low-voiced conference.

With a last nod at the feline, Galiol looked up at Jevan and said briskly, "Continue."

They continued—opening bales and crates, pulling the tops off barrels or tapping them, laying out hundreds of items for inspection, one by one: spices, perfumed oils with fresh earthy scents, wines, spiced teas—until even Jevan was beginning to feel inundated by it. Galiol studied each . . . feeling, tasting, smelling, his head inclined toward the consultants for comments. The opinions the feline expressed were never loud enough for anyone but the trader to hear, though, and Casus's masked face remained impassive. And Galiol never reacted. His copper eyes were unreadable, his expression noncommittal.

"Is this all?" he asked finally, studying a tangle of silver filaments floating in a liquid-filled globe. Activated by sound, the filaments flowed into an endlessly changing pattern of linear and geometric designs.

"Just one more item," Jevan said. He signaled to his two men.

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Ilith and Birn dragged crates away from a tall metal cube. Small ovals were arranged in a square in the center of the facing side. Crossing to it, Jevan punched a complicated pattern on the ovals. Something inside hummed and the front of the cube slid open. The captain removed a traylike shelf and set it on a barrel by Galiol.

The trader looked into the tray —and up at the Andvarian in disbelief. "What are *these?*" he demanded, gesturing at the rows of dull, irregular crystals.

"Look closer."

His expression skeptical, Galiol picked up a blue one. "Flawed quartz," he pronounced. "Poor color, clouded, utterly worth . . ." His voice trailed off.

"Oh," Danae gasped.

In his hand the stone had changed. The center began to glow, faintly at first, then brighter, the radiance spreading to every facet and angle of the crystal. The aliens stared at the jewel, now a fiery blue.

Galiol whipped around to face Jevan, but before he could ask the question forming on his lips, the Andvarian answered, "Fire gems. They're mined by robot from a planet with very heavy gravity and a poisonous atmosphere which make any other method impossible. I don't think I need to add that such gems are worth a fortune."

Danae translated somewhat breathlessly.

Her employer frowned reprovingly at her. "What makes the stones glow?"

"Heat-sensitive particles within the substance of the stone, or so I'm told. Supposedly they react to body heat." He picked up a red gem and a green one, held them until they, too, blazed. "The one jewel which cannot be locked away and gloated over. It must be worn to be beautiful," he murmured.

Reverently, he replaced them in the tray. Taking the blue one from Galiol, he was about to put it back, too, then changed his mind.

"Lock the rest up, Birn. Well, Galiol?"

The biped's eyes remained locked on the fire gem. "You have a number of items I would have no trouble selling. Others will not bring much, being very like merchandise already on the market, but I think perhaps advertising them as being of alien origin might help."

"You're interested in buying my cargo, then."

The trader tore his eyes away from the glowing jewel with difficulty and met Jevan's eyes. "I believe in being frank, Captain. I am *very* interested in your cargo."

"Then we have only to discuss terms."

"Excellent. Zaal . . . the contract."

The reptilian lawyer took papers from his case and came over to stand beside Galiol.

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"What are you offering?" Jevan asked.

"We can deal in one of two ways. Either I can give you a flat payment and buy the goods outright, or you can consign the goods to me and split the sale price on a percentage basis. Usually, if the cargo is a single one, I purchase it. On the chance, however, that our dealings might become a regular occurrence, I am willing to take your cargo on consignment."

Jevan watched the girl keenly but not a flicker of expression showed in either face or eyes as she translated. His tail switched.

"What kind of percentage do you ask on consignment?" he asked.

"I try to make my fee as low as possible . . . low as possible, that is, and still make a little profit."

"How much?" Jevan prodded.

The trader smiled—like a shark, Jevan reflected—and said calmly, "Seventy percent."

The Andvarian's eyes rimmed white. "What!" he screamed. "That's piracy!"

"I cannot possibly ask for less."

"Oh, of course not." Jevan snarled. "And how much do you pay for complete rights to a cargo, a tenth of the value?"

"There is no need to be nasty, Captain," Galiol chided mildly. "As for buying . . . of course you receive less than you would on a consignment contract, but I pay a full twenty-five percent of the projected selling price."

"Leaving you with three-quarters, plus the difference between the estimate and actual sales."

"I run a business, Captain Jevan."

The skin along the Andvarian's equine shoulders twitched. "Ilith," he said coldly, "show our guests to the hatch."

"As you wish." Galiol turned on his heel. "It is not I who must take an unsold cargo all the way back to my point of origin." He kept moving toward the door, signaling his staff to follow.

"We'll market the goods here ourselves."

The alien stopped and turned. "Will you now. I might warn you of a few minor difficulties, Captain. First and foremost, you lack the necessary command of the language. Then, you don't know the Federation, nor navigation here, nor the markets and trade regulations, which surely you must realize exist here as undoubtedly they do in your part of space." He glanced toward the lawyer. "Zaal, will you mention a few of the legal problems he will encounter—and the fees?"

Pupils contracted to hairline slits, the reptile ticked off the points on his fingers. "Ship registry, Federation licensing, Traders' Guild membership, assignment of subspace channel for communications—obtained only through lengthy processes from Central Communications—registry in the Galactic market,

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inspection fees, port fees, tariffs . . ."

"You've made your point," Jevan interrupted. "But don't these problems still exist if you handle the cargo?"

"Yes, but they're *my* problem. I already have all the necessary registries and memberships, and I retain agents and a sizable legal staff to cope with the rest." He came back and sat down. "And I might add that such payments as have to be made come out of my percentage. Your portion is figured from the gross sale price."

Jevan shook his head. "But the most I can get, in any case, is thirty per cent."

"Consider the economics," Galiol purred. "You are one ship with a single crew to share the profits. I have a large corporation, with the accompanying heavy taxes, ship upkeep, salaries . . ."

Jevan lifted a skeptical brow but said nothing.

The alien went on smoothly, "Speaking in terms of money instead of percentages, a sale of as little as one million credits worth of goods on a single planet brings you three hundred thousand credits. I can't equate that to the money in your society but among us, it is a healthy sum. And a million credits is a conservative estimate."

Jevan felt Ilith and Birn watching him intently. "Three hundred thousand per planet."

"Per planet. The Federation consists of over nine hundred member planets."

Ilith's tail smacked softly against a crate. Jevan glanced at her . . . saw her eyes were narrowed but blank, computations clicking away almost audibly in her head.

He looked back at Galiol. "How do I collect on a consignment?"

"Sales are totaled every trimester and the proper payment assigned to the consignor at that time."

The Andvarian frowned. "That means months before we can hope to earn anything off this cargo."

Galiol shrugged. "I can hardly divide sales that haven't been made."

"Do you ever give advances?"

"To be subtracted from your first payment?" Galiol pursed his lips thoughtfully. "I don't make it a practice, but in your case, I think I could allow it."

"Good."

"Of course, it's only fair to warn you that your cargo may not sell as well as we hope. I can't control the vagarities of the buying public. They may decide your goods are too expensive or too exotic. We may have to sell them at reduced prices to sell at all. An advance on the basis of projected buying could consume all of your first trimester profits and part of your second. You may not be able to collect additional payment until the next fiscal year."

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"Are you trying to advise me against a consignment contract?" Jevan asked, eyes narrowed.

"Now, Captain," Galiol said silkily, "far be it from me to sway you one way or the other. But consignments can be risky."

"Suppose I offered to let you buy the cargo. We would be receiving twenty-five percent of what?"

Something flickered behind the trader's eyes. "For the privilege of outright purchase, I would be willing to figure on the basis of three million credits of sales per planet."

Jevan heard the computations clicking in Ilith's head again, and the sharp movement of her tail as she came up with the dazzling total. "You would take a chance on losing your profit if my goods don't sell?" He had difficulty keeping sarcasm out of his voice.

Galiol smiled. "I can afford to gamble, Captain."

The Andvarian's tail flicked at his flanks and hocks.

"Well, Captain?" Galiol asked. "Will you sell your cargo, risk it on consignment . . . or take it home?"

Face stony, Jevan replied, "As you so correctly pointed out, I can't afford to gamble. I'll sell you the cargo."

"Excellent." Beaming, Galiol turned to the lawyer. "Get the contract ready to sign, Zaal. How would you like to be paid, Captain?"

"What possible ways are there?"

"Several. Federation currency is, of course, out of the question, but I can give you an equivalent value in gems and/or precious metal."

Jevan shook his head. "They won't be worth the same in the Commonwealth. Can we take it in trade goods?"

"I was about to suggest that."

"I'll take payment in trade goods, then."

For the first time, reaction showed in Danae's face. The girl frowned almost imperceptibly. Jevan ignored her.

Galiol signed the contract with a flourish and handed it to the captain. "Read it to him, Danae. If the terms are correct, Captain, sign across the page from my name."

The girl translated, reading slowly and carefully. When she finished, Jevan took it and briskly signed where Galiol indicated, then returned it to the lawyer.

Galiol stood up and extended a hand to Jevan, who stared at it blankly. The trader laughed. "I forget that customs differ between races. It's been a pleasure dealing with you. You may choose your goods from my trader and our crew can begin transferring cargo immediately."

The captain nodded. "Thank you. Ilith, if you will conduct our guests to the hatch—politely, this time."

"Yes, sir." Bowing, she escorted the aliens from the hold.

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"Alert the crew, Birn," Jevan went on.

The little supercargo grinned and trotted out. Left alone, Jevan looked around, laughed deep in his chest, and tossed the glowing blue jewel. He caught it deftly and stared deep into the fiery heart.

"Captain . . ."

He looked around to see Danae in the doorway. He smiled. "Yes?"

She came slowly toward him. "I'm sorry, Captain."

"About what?"

"I couldn't tell you then—that would have been disloyal to Galiol—but he's done just what I warned you he might. He'll make over twice as much as he estimated."

"There's no way to be sure," Jevan said soothingly. She was obviously very distressed.

"He's sure," the girl said emphatically. "He wouldn't have given you the price he did otherwise."

Jevan patted her shoulder. "It doesn't matter. I have trade goods to sell my own people in return."

"But the *kind* of goods he's giving you!" she protested bitterly. "It's third class. Not shoddy, just common, ordinary—the baubles and glass beads of our civilization."

The Andvarian chuckled. Much to her astonishment he said, "I'm glad. My conscience might have bothered me otherwise."

"I . . . I don't understand."

Jevan tossed the fire gem. "What do you think I sold *him?* Certainly not the treasures of Andvari. I couldn't afford to buy the best, nor even second best."

Her silver eyes grew huge. She whispered, "Galiol will—"

"Won't say a word. Value, my romantic child, is a relative thing. Your people don't have these items so to you they're valuable. Galiol has lost nothing. The same is true of your goods and my people. Unlimited trade will establish true values, but that's far in the future yet, and by the time it happens, Galiol and I will have profited hugely."

She stared. Suddenly she laughed and threw her arms around his muscular torso. "You pirate. What a coup."

"And why are you so astonished? My race is only less advanced than yours, not necessarily an inferior." Unwinding one of her arms from around him, he dropped the fire gem in the palm of her hand. "A souvenir. There are genuine stones, by the way, mined just the way I said . . . or they were until these synthetic copies made them unprofitable."

His eyes, looking down into hers, reflected greenly. "My civilization has glass beads, too." ■

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HEAVY DUTY

"What you get for nothing is worth it!" And on a bleak, heavy planet—the future can look like a free gift . . .

HANK DEMPSEY

Illustrated by Vincent diFate

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"But why you?" Keriza complained.

"Because it happens to be my job." He clicked the last belt loop into place on his pack and shifted its weight comfortably on his shoulders.

"I don't understand why those men, the ones flying the delivery ship, why they couldn't have looked around first—to help you out a little bit, perhaps let you know what you were getting into. I don't think it's fair."

"It's very fair," he told her, tightening up one notch on the left shoulder strap and trying to keep his temper. He did not like her to come here when he was leaving, but there was no easy way to stop her. Once again he explained.

"The men who fly the contact ships have a difficult time of it just staying alive and sane, trapped in their ships while they go out to the stars. Theirs is a specialized job, only certain men with particular dispositions can survive the long flight. These same characteristics are outstandingly unsuited to planetary contact and exploration. It is work enough for them to do a high-level instrument and photographic sweep, and then to drop a transmatter screen on retrojets at a suitable spot. By the time the transmatter touches down and sends back their report they are well on their way to the next system. They've done their job. Now I'll do mine."

"Ready for me yet, Specialist Langli?" a man asked, looking in through the ready room door.

"Just about," Langli said, disliking himself for the relief he felt at the other's intrusion. "Artificer Meer, this is my wife, Keriza."

"A great honor, Wife Keriza. You must be proud of your husband."

Meer was young and smiled when he talked, so it could be assumed that he was sincere about what he said. He wore a throat mike and earphones and was in constant contact with the computer.

"It is an honor," Keriza said, but could not prevent herself from adding, "but not an eternal one. This is a first betrothal and it expires in a few days, while my husband is away."

"Fine," Artificer Meer said, not hearing the bitterness behind her words: "You can look forward to a second or final when he returns. A good excuse for a celebration. Shall I begin, Specialist?"

"Please do," Langli said, lifting his canteen with his fingertips to see if it was full.

Keriza retreated against the wall of the drab room while the checklist began: she was already left out. The computer murmured its questions into the artificer's ear and he spoke them aloud in the same machine-made tones. Both men attended to the computer, not to her, alike in their dark green uniforms, almost the same color as the green-

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painted walls. The orange and silver of her costume was out of place here and she stepped backwards towards the entrance, all unconsciously.

The checklist was run through quickly and met the computer's approval. Far more time was then taken up making the needed adjustments on Langli's manpower gear. This was a powered metal harness that supported his body, conforming to it like a flexible exoskeleton. It was jointed at his joints and could swivel and turn to follow any motion. Since the supporting pads were an integral part of his uniform, and the rods were thin and colored to match the cloth, it was not too obvious. An atomic energy supply in his pack would furnish power for a year.

"Why are you wearing that metal cage?" Keriza asked. "You have never done that before." She had to repeat her question, louder, before either man noticed her.

"It's for the gravity," her husband finally told her. "There's a 2.153+ G on this planet. The manpower can't cancel that, but it can support me and keep me from tiring too quickly."

"You didn't tell me that about this planet. In fact you have told me nothing—"

"There's little enough. High gravity, cold and windy where I'm going. The air is good, it's been tested, but oxygen is a little high. I can use it."

"But animals, wild animals, are there any of them? Can it be dangerous?"

"We don't know yet, but it appears peaceable enough. Don't worry about it." This was a lie, but one officially forced upon him. There were human settlers on this new planet, and this was classified information. A public announcement would be made only after official appraisal of his report.

"Ready," Langli said, pulling on his gloves. "I want to go before I start sweating inside this suit."

"Suit temperature is thermostatically controlled, Specialist Langli. You should not be uncomfortable."

He knew that: he just wanted to leave. Keriza should not have come here.

"Restricted country from here in," he told her, taking her arms and kissing her quickly. "I'll send you a letter as soon as I have time."

He loved her well enough, but not here, not when he was going on a mission. The heavy door closed behind them, shutting her out, and he felt relieved at once. Now he could concentrate on the job.

"Message from Control," the artificer said when they entered the armored transmatter room through the thick triple doors. "They want some more vegetation and soil samples. Life forms and water, though these last can wait."

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"Will comply," Langli said, and the artificer passed on the answer through his microphone.

"They wish you quick success, Specialist," the artificer said in his neutral voice then, more warmly, "I do, too. It is a privilege to have assisted you." He covered the microphone with his hand. "I'm studying, a specialist course, and I've read your reports. I think that you—I mean what you have done—" His words died and his face reddened. This was a breach of rules and he could be disciplined.

"I know what you mean, Artificer Meer, and I wish you all the best of luck." Langli extended his hand and, after a moment's reluctance, the other man took it. Though he would not admit it aloud, Langli was warmed by this irregular action. The coldness of the transmatter chamber, with its gun snouts and television cameras, had always depressed him. Not that he wanted bands, or flags, when he left, but a touch of human contact made up for a lot.

"Good-bye, then," he said, and turned and activated the switch on the preset transmatter control. The wire lattice of the screen vanished and was replaced by the watery blankness of the operating Bhattacharya field. Without hesitating Langli stepped into it.

An unseen force seized him, dragging him forward, hurling him face first, to the ground. He threw his arms out to break his fall and the safety rods on his wrists shot out ahead of his hands, telescoping slowly to soften the shock of impact; if they had not he would surely have broken both his wrists. Even with this aid the breath was knocked from him by the impact of the manpower pads. He gasped for air, resting on all fours. His mouth burned with the coldness of it and his eyes watered. The uniform warmed as the icy atmosphere hit the thermocouples. He looked up.

A man was watching him. A broad, solidly built man with an immense flowing black beard. He was dressed in red-marked leather and furs and carried a short stabbing spear no longer than his forearm. It was not until he moved that Langli realized he was standing up—not sitting down. He was so squat and wide that he appeared to be truncated.

First things came first: Control had to have its samples. He kept a wary eye on the bearded man as he slipped a sample container from the dispenser on the side of his pack and put it flat on the ground. The ground was hard, but ridged, like dried mud, so he broke off a chunk and dropped it into the middle of the red plastic disk. Ten seconds later, as the chemicals in the disk reacted with the air, the disk curled up on the edges and wrapped the soil in a tight embrace. The other man shifted his spear from hand to hand and

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watched this process with widening eyes.

Langli filled two more containers with soil, then three others with grass and leafy twigs from a bush a few feet away. This was enough. Then he backed slowly around the scarred bulk of the retrorockets until he stood next to the transmatter screen. It was operating but unfocused: anything entering it now would be broken down into Y-radiation and simply sprayed out into Bhattacharya space. Only when he pressed his hand to the plate on the frame would it be keyed to the receiver: it would operate for no one else.

He touched the plate and threw the samples through. Now he could turn to the more important business.

"Peace," Langli said, facing the other man with his hands open and extended at his sides. "Peace."

The man did nothing in response—though he raised the spear when Langli took a step towards him. When Langli returned to his original position he dropped the spear again. Langli stood still and smiled.

"It's a waiting game, is it? You want to talk while we're waiting?" There was no answer, nor did he really expect one. "Right then, what is it we're waiting for? Your friends, I imagine. All of this shows organization which is very hopeful. Your people have a settlement nearby, that's why the transmatter was dropped here. You investigated it, found no answers, then put a guard on it. You must have signaled them when I arrived, though I was flat on my face and didn't see it."

There was a shrill squealing behind a nearby slope that slowly grew louder. Langli looked on with interest as a knot of bearded men, at this distance looking identical with his guard, struggled into sight. They were all pulling a strange conveyance which had three pairs of wooden wheels: the apparently unoiled axles were making the squealing. It was no more than a padded platform on which rested a man dressed in bright red leather. The upper part of his face was hidden by a metal casque pierced with eyeslits, but from below the rim a great white beard flowed across his chest. In his right hand the man held a long, thin-bladed carving knife which he pointed at Langli as he slowly stepped down from the conveyance. He said something incomprehensible in a sharp hoarse voice at the same time.

"I'm sorry, but I cannot understand you," Langli said.

At the sound of his words the old man started back and nearly dropped the weapon. At this sudden action the other men crouched and raised their spears towards Langli. The leader disapproved of this and shouted what could only

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have been commands. The spears were lowered at once. When he was satisfied with the reaction the man turned back to Langli and spoke slowly, choosing his words with care.

"I did not know . . . think . . . I would these words hear spoken by another. I know it only to read." The accent was strange but the meaning was perfectly clear.

"Wonderful. I will learn your language, but for now we can speak mine—'"

"Who are you? What is it . . . the thing there, it fell at night with a loud noise. How come you here?"

Langli spoke slowly and clearly, what was obviously a prepared speech.

"I come with greetings from my people. We travel great distances with this machine you see before you. We are not from this world. We will help you in many ways which I will tell you. We can help the sick and make them well. We can bring food if you are hungry. I am here alone and no more of us will come unless you permit it. In return for these things we ask only that you answer my questions. When the questions are answered we will answer any questions that you may have.'"

The old man stood with his legs widespread and braced, unconsciously whetting the blade on his leg. "What do you want? What are your needs . . . desires?"

"I have medicine and can help the sick. I can get food. I ask only that you answer my questions, nothing more."

Under the flowing moustache the old man's lips lifted in a cold grin. "I understand. Do as you say—or do nothing. Come with me then." He stepped backwards and settled slowly onto the cart which creaked with his weight. "I am Bekrnatus. You have a name?"

"Langli. I will be happy to accompany you."

They went in a slow procession over the crest of the rise and down into the shallow valley beyond. Langli was already tired, his heart and lungs working doubly hard to combat the increased gravity, and was exhausted before they had gone a quarter of a mile."

"Just a moment," he said. "Can we stop for a short while?"

Bekrnatus raised his hand and spoke a quick command. The procession stopped and the men immediately sat, most of them sprawling out horizontally in the heavy grass. Langli unclipped his canteen and drank deeply. Bekrnatus watched every move closely.

"Would you like some water?" Langli extended the canteen.

"Very much," the old man said, taking the canteen and examining it closely before drinking from it. "The water has a taste of very difference. Of what metal is this . . . container made?"

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"Aluminum I imagine, or one of its alloys."

Should he have answered that question? It certainly seemed harmless enough. But you never could tell. Probably he shouldn't have, but he was too tired to really care. The bearded men were watching intently and the nearest one stood up, staring at the canteen.

"Sorry," Langli said, blinking a redness of fatigue from his eyes and extending the canteen to the man. "Would you like a drink as well?"

Bekrnatus screamed something hoarsely as the man hesitated a moment—then reached out and clutched the canteen. Instead of drinking from it he turned and started to run away. He was not fast enough. Langli looked on, befuddled, as the old man rushed by him and buried his long knife to the hilt in the fleeing man's back.

None of the others moved as the man swayed, then dropped swiftly and heavily to the ground. He lay on his side, eyes open and blood gushing from his mouth, the canteen loose in his fingers. Bekrnatus kneeled and took away the canteen, then jerked the knife out with a single powerful motion. The staring dead eyes were still.

"Take this water thing and do not come . . . go near other people, or give them anythings."

"It was just water—"

"It was not the water. You killed this man."

Langli, befuddled, started to tell him that it was perfectly clear who had killed him, then wisely decided to keep his mouth shut. He knew nothing about this society and had made a mistake. That was obvious. In a sense the old man was right and he *had* killed the man. He fumbled out a stimulant tablet and washed it down with water from the offending canteen. The march resumed.

The settlement was in the valley, huddled against the base of a limestone cliff, and Langli was exhausted when they reached it. Without the manpower he could not have gone a quarter of this distance. He was in among the houses before he realized they were there, so well did they blend into the landscape. They were dugouts, nine tenths below the ground, covered with flat sod roofs: thin spirals of smoke came from chimney openings in most of them.

The procession did not stop, but threaded their way through the dug-in houses and approached the cliff. This had a number of ground-level openings cut into it, the larger ones sealed with log doors. When they were closer Langli saw that two windowlike openings were covered with glass or some other transparent substance. He wanted to investigate this—but it would have to wait. Everything would have to wait until he regained a measure of strength.

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He stood swaying while Bekrnatus climbed slowly down from the wheeled litter and approached a log door which opened as he came near. Langli started after him—then found himself falling, unable to stand. He had a brief moment of surprise, before the ground came up and hit him, when he realized that for the first time in his life he was fainting.

The air was warm on his face and he was lying down. It took him some moments, even after he had opened his eyes to realize where he was. An immense fatigue gripped him and every movement was an effort; even his thoughts felt drugged. He looked about the darkened room several times before the details made any meaning: A window that was set deep into the stone wall, the dim bulk of furniture and unknown objects, a weaker, yellow light from the fire on the grate, a stone fireplace and stone walls. Memory returned and he realized that he must be in one of the rooms he had noticed, hollowed out of the face of the cliff. The fire crackled, there was the not-unpleasant odor of pungent smoke in the air, soft, slapping footsteps came up behind him. He felt too tired to turn his head, but he banished this unworkmanlike thought and did turn in that direction.

A girl's face, long blond hair, deep blue eyes.

"Hello. I don't believe we have met," he said.

The eyes widened, shocked, and the face vanished. Langli sighed wearily and closed his own eyes. This was a very trying mission. Perhaps he should take a stimulant. In his pack—

His pack! He was wide-awake at the thought, struggling to sit up. They had taken his pack from him! At the same instant of fear he saw it lying next to the cot where it had been dropped. And the girl returned, pressing him back to a lying position. She was very strong.

"I'm Langli. What's your name?"

She was attractive enough, if you liked your girls squarefaced. Too broad-shouldered, too hippy, too much muscle. Very little different really from the other natives of this heavy planet. He realized that her eyes had never left his while he had been looking her up and down. He smiled.

"Langli is my name, but I suppose I shall never learn yours. The leader, what did he call himself?, Bekrnatus seems to be the only one who speaks a civilized tongue. I suppose I shall have to learn the local runts and gurgles before I will be able to talk to you?"

"Not necessarily," she said, and burst out laughing at the surprised look on his face. Her teeth were even, white and strong. "My name is Patna. Bekrnatus is my father."

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"Well, that's nice." He still felt dazed. "Sorry if I sounded rude. The gravity is a little strong for me."

"What is gravity?"

"I'll tell you later, but I must talk to your father first. Is he here?"

"No. But he will be soon back. Today he killed a man. He must now the man's wife and family look after. They will go to another. Can I not answer your questions?"

"Perhaps." He touched the button on his waist that switched on the recorder. "How many of your people speak my language?"

"Just me. And father, of course. Because we are The Family and the others are The People." She stood very straight when she said it.

"How many are there, of The People I mean?"

"Almost six hundred. It was a better winter than most. The air was warmer than in other years. Of course there was more—what is the word?—more rot in the stored food. But people lived."

"Is winter over yet?"

She laughed. "Of course. It is almost the warmest time now."

And they believe that this is warm, he thought. *What can the winters be possibly like?* He shivered at the thought.

"Please tell me more about The Family and The People. How are they different?"

"They just are, that's all," she said and stopped, as though she had never considered the question before. "We live here and they live there. They work and they do what we tell them to do. We have the metal and the fire and the books. That is how we talk your language, because we read what is written in the books."

"Could I see the books?"

"No!" she was shocked at the thought. "Only The Family can see them."

"Well—wouldn't you say that I qualify as a member of The Family? I can read, I carry many things made of metal." At that moment he realized what the trouble had been with his canteen. It was made of metal, for some reason taboo among most of these people. "And I can make fire." He took out his lighter and thumbed it so that a jet of flame licked out.

Patna looked at this, wide-eyed. "Our fires are harder to make. But, still, I am not sure. Father will know if you should look at the books." She saw his expression and groped around for some compromise. "But there is one book, a little book, that father lets me have for my own. It is not an important book though."

"Any book is important. May I see it?"

She rose hesitantly and went to the rear of the room, to a log door let into the stone, and tugged at the thick bars. When it was open

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she groped into the darkness of another room, a deeper cavern cut into the soft stone of the cliff. She returned quickly and resealed the door.

"Here," she said, holding it out to him. "you may read my book."

Langli struggled to a sitting position and took it from her. It was crudely bound in leather—the original cover must have worn out countless years earlier—and it crackled when he opened it. The pages were yellowed, frayed and loose from the backbone. He poked through them, squinting at the archaic typeface in the dim light from the window, then turned back to the title page.

"Selected poems," he read aloud. "Published at, I've never heard of the place, in—this is more important—785 P.V. I think I've heard of that calendar . . . just a moment."

He put the book down carefully and bent to his pack, almost losing his balance as the more than doubled gravity pulled at him. His exoskeleton hummed and gave him support. The handbook was right on top and he flipped through it.

"Yes, here it is. Only went to 913 in their reckoning. Now to convert to Galactic Standard—" He did some silent figuring and put the handbook away, taking up the other book again. "Do you like poetry?" he asked.

"More than anything. Though I only have these. There are no other poems in the books. Though there are *some* others—"

She lowered her eyes and, after a moment's thought, Langli realized why.

"These others, you wrote them yourself, didn't you? You must tell me one some time—"

There was a sudden rattling at the bolts that sealed the front door and Patna tore the book from his hands and ran with it to the dark end of the room.

Bekrnatus pushed open the door and came in wearily. "Close it," he ordered as he threw aside his helmet and dropped into a padded lounge, half bed, half chair. Patna moved quickly to do his bidding.

"I am tired, Langli," he said, "and I must sleep. So tell me what you are doing here, what this all means."

"Of course. But a question or two first. There are things I must know. What do your people do here, other than sleep and eat and gather food."

"The question makes no sense."

"I mean anything. Do they mine and smelt metal? Do they carve, make things from clay, paint pictures, wear jewelry—"

"Enough. I understand your meaning. I have read of these things, seen pictures of them. Very nice. In answer to your question—we do nothing. I could never understand how these things were done and perhaps you will tell me

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when it suits you to answer questions rather than ask them. We live, that is hard enough. When we have planted our food and picked our food we are through. This is a hard world and the act of living takes all of our time."

He barked a harsh command in the local language, and his daughter shuffled to the fireplace. She returned with a crude clay bowl which she handed to him. He raised it to his lips and drank deeply, making smacking noises with his lips.

"Would you care for some?" he asked. "It is a drink we make, I do not know if there is a word for it in the book language. Our women chew roots and spit them into a bowl."

"No, none thank you." Langli fought to keep his voice even, to control his disgust. "Just one last question What do you know of your people coming to this world? You do know that you came here?"

"Yes, that I know, though little more. The story is told, though nothing is written, that we came from another world to this world, from the sky, though how it was done I know not. But it was done, for the books are not of this world and they have pictures of scenes not of this world. And there is the metal, and the windows. Yes, we came here."

"Have others come? Like myself. Are there records?"

"None! That would have been written. Now you tell me, stranger from the metal box: What do you do here?"

Langli lay down, carefully, before he spoke. He saw that Patna was sitting as well. The gravity must be fought, constantly, unceasingly.

"First you must understand that I came from inside the metal box, then again I didn't. At night you see the stars and they are suns like the one that shines here, yet very distant. They have worlds near them, like this world here. Do you know what I am talking about?"

"Of course. I am not of The People. I have read of astronomy in the books."

"Good. Then you should know that the metal box contains a transmatter which you must think of as a kind of door. One door that is at the same time two doors. I stepped through a door on my planet, very far away, and stepped out of your door here. All in an eyeblink of time. Do you understand?"

"Perhaps." Bekrnatus dabbed at his lips with the back of his hand. "Can you return the same way? Step into the box and come out on a planet, up there in the sky?"

"Yes, I can do that."

"Is that how we came to this world?"

"No. You came by a ship of space, a large metal box built to move between the stars, in the

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years before the transmatter could be used at stellar distances. I know this because your window there is the window from a spacer, and I imagine your metal was salvaged from the ship as well. And I also know how long you have been here, since there was a date in the front of that poetry book your daughter showed me."

Patna gasped, a sharp intake of air, and Bekrnatus pulled himself to a sitting position. The clay bowl fell, unheeded, and shattered on the floor.

"You showed him a *book*," Bekrnatus hissed, and struggled to his feet.

"No, wait!" Langli said, realizing he had precipitated another crisis through ignorance. Would the man try to kill his daughter? He tore at his pack. "It was my fault, I asked for the book. But I have many books. Here I'll show you. I'll give you some books. This . . . and this."

Bekrnatus did not heed the words, if he even heard them, but he stopped as the books were pushed before him. He reached for them hesitantly.

"Books," he said, dazedly. "Books, new books, books I have never seen before. It is beyond wonder."

He clutched the books to his chest and half fell back into his chair. A good investment, Langli thought. Never was a first reader and a basic dictionary more highly prized.

"You can have all the books you want now. You can discover your history, all of it. I can tell you that your people have been here, roughly, about three thousand years. Your coming here may have been an accident, two things lead me to believe that. This is a very grim world with little to offer. I can't picture it being selected for colonization. Then there is the complete break with technology and culture. You have a few books, they could have been salvaged. And metal, perhaps from the wreck of the ship. That you have survived is little short of miraculous. You have this social or class distinction that has also passed down. Your ancestors were perhaps scientists, ship's officers, something that set them apart from ordinary men. And you have kept the distinction."

"I am tired," Bekrnatus said, turning the books over and over in his hands, "and there are many new things to think about all at once. We will talk tomorrow."

He dropped back, eyes closed, books still in his grasp. Langli was ready to sleep himself, exhausted by the efforts he had forced himself to. The light seemed to be fading; he wondered how long the local day was, and did not really care. He took an eight-hour sleeping pill from his medical kit and washed it down with water from

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his canteen. A night's sleep would make things look quite different.

During the night he was aware of someone moving about, going to the fire. At one time he thought he felt the soft touch of hair across his face and lips upon his forehead. But he could not be sure and it was probably a dream.

It was bright morning when he awoke, with the sun striking directly through the window, the shaft of light adding unexpected color to the gray stone of the back wall. Bekrnatus's couch was empty and Patna was working at the fireplace, humming quietly to herself. When he shifted position his bed squeaked and she turned to look at him.

"You are awake. I hope that you slept well. My father has gone out with the ax so wood can be chopped."

"You mean that he chops the wood?" Langli yawned, his head still thick with sleep.

"No, never. But the ax head is metal so he carries it and must be there when it is used. Your morning food is ready." She ladled one of the clay bowls full of gruel and brought it to him. He smiled and shook his head no.

"Thank you, that is very hospitable. But I cannot eat any of your food until laboratory analysis has been made—"

"You think I am trying to poison you?"

"Not at all. But you must realize that major metabolic changes take place in human beings cut off from the main stream. There may be chemicals in the soil here, in the plants, that you can ingest but that would be sure death for me. It smells wonderful, but it could hurt me. You wouldn't want that to happen?"

"No! Of course not." She almost hurled the bowl from her. "What will you eat?"

"I have my own food here, see."

He opened his pack and took out a mealcel, pulling the tab so the heating began. He was hungry, he realized, hungrier than he had ever felt before, and began spooning down the concentrate before the heat cycle was finished. His body needed nourishment, fighting constantly against the drag of gravity.

"Do you know what this is?" Patna asked, and he looked up to see her holding a brownish, ragged-edged fragment of some kind.

"No, I don't. It looks like wood, or bark."

"It is the inner bark of a tree, we use it to write on, but that is not what I meant. I meant there is something *on* it. That is what I meant—"

Even in the dim light Langli could realize that she was blushing. Poor girl, a literate among savages, trapped on this dismal and isolated world.

"I might guess," he said care-

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fully. "Could it be one of the poems you wrote? If it is—I would like to hear it."

She shielded her eyes with her hand and turned away for a moment, a caricature of a shy maiden in a squat wrestler's body. Then she struggled with herself and started the poem in a weak voice, but continued, louder and louder. "I dare not ask a kiss,

I dare not beg a smile,
Lest having that, or this,

I might grow proud the while.
No, no, the utmost share

Of my desire shall be
Only to kiss the air

That lately did kiss thee."

She almost cried the last words aloud, then turned and fled to the far side of the room and stood with her face against the wall. Langli groped for the right words. The poem was good, whether she had written it herself or copied it he did not know—nor did it matter. It said what she wanted to say.

"That's beautiful," he told her. "A really beautiful poem—"

Before he could finish she ran, feet slapping hard against the floor, across the room and knelt beside his bed. Her solid, powerful arms were about him and her face against his, buried in the pillow. He could feel the tear-wetness of her cheeks against his own and her muffled voice in his ear.

"I knew you would come, I know who you are, because you had to come from far away like a knight in the poems riding a horse to save me. You knew I needed you. My father, I, the only Family left, must marry one of The People. It has been done before. Ugly, stupid, I hate them, the brightest, we tried to teach him to read, he couldn't, stupid. But you came in time. You are The Family, you will take me—"

The words died away and her lips found his, urgent and strong with desire, and when he held her shoulders and tried to push her away his exoskeleton whined with the effort but she did not move. Finally, exhausted, she released him and pushed her face deep into the pillow again. He stood, swaying, bracing himself on the back of a chair. When he spoke it was with sincerity as he tried to make the truth less harsh than it really was.

"Patna, listen, you must believe me. I like you, you're a wonderful brave girl. But this just can't be. Not because I am already married, that marriage will be terminated before I return, but because of this world. You can't leave it, and I would die if I stayed here. The adaptations your people have been forced to make to survive must be incredible. Your circulatory system alone must be completely different. Your blood pressure much more than normal to get blood to your brain, with more muscles in the walls of the arteries to help pump it. Perhaps major valve changes

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and distribution. You can't possibly have children with anyone from off this planet. Your children would be stillborn, or die soon after birth, unfit. That is the truth, you must believe—"

"Ugly, skinny, too tall, too weak, shut up!" she screeched and lashed out at him, her head still turned away.

He tried to move aside, he could not, not fast enough. Her hand slapped against his arm with a sudden explosion of pain. A sharp cracking sound.

She's broken my arm, he screamed to himself, staggering, sitting down slowly. His forearm hung crookedly in the brace of the exoskeleton and how it hurt. He cradled it on his knees and fumbled through his medical supplies with his good hand. She tried to help him and he snarled at her and she went away.

Bekrnatus came in, an ax over his shoulder, while the emergency cast was hardening and Langli was giving himself a shot of painkiller, with a tranquilizer for his nerves.

"What is wrong with your arm?" Bekrnatus asked, dropping the ax and falling into his couch.

"I had an accident. I will have to go get medical help from my people soon so I must talk to you now. Tell you what you need to know—"

"Do that. I have questions—"

"There is no time for questions." The pain was still there and he snapped the words out. "If I had the time I would explain everything slowly and in great detail so you would understand and agree. Now I will just tell you. If you want help, you must pay for it. It costs a great deal to plant an MT screen on a planet as distant as this one. Medical supplies, food, energy sources, anything that we supply you will also cost a good deal. You will have to repay us."

"You have our thanks, of course."

"Not negotiable!" The pain was almost gone, but he could feel the broken ends of the bones grate together when he moved. His nerves felt the same way despite the tranquilizer.

"Listen carefully and try to remember what I say. There is no pie in the sky. What you get for nothing is worth it. Out there are more planets than you could possibly count—and more people on them than *I* could count. And the transmatter makes them all next door neighbors. Can you imagine what hell that has wreaked with culture, government, finances down through the millennia? No, I can see by your face that you can't. Then just think about this one bit of it. To further certain ends individuals form a cooperation, a sort of cross between a cooperative and a corporation, if those words are in any of your books. I belong to one of these

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called World Openers. We explore unsettled planets and occasionally contact worlds like yours that aren't on the MT net. For services rendered we demand payment in full."

Patna had come to stand by her father, silently, her arm about his thick knobbed shoulders. Her face, as she looked at Langli, was a study in hatred, contempt. Bekrnatus, a lord on his own world, would still not comprehend the realities of the galaxy outside.

"We will pay what you ask, gladly, but pay with what? We have no money, none of the resources you were asking about last night."

"You have yourselves," Langli said, emotionlessly, as the drugs took hold. "Because that is all you have it will take generations to repay your debt. You will breed faster and better, and we will help you with that. For a price of course. We have operations on heavy gravity worlds that must be supervised. Automatic machinery can't do everything. And there are others who can use workers of your type as well—"

"You come to enslave us, imprison us!" Bekrnatus roared. "To make free men into beasts of burden. Never!"

He grabbed up the ax from the floor and climbed to his feet, swinging it high. Langli was ready. His gun snapped just once and the explosion shook the room as a great pit was blown from the stone wall behind Bekrnatus.

"Just imagine what that would have done to you. Now sit down and don't be foolish. I will kill you to save my own life, be sure of that. We can't imprison you—because you are in prison already on this high G world. The force that pulls you down, that makes things fall when dropped . . . this force is weaker on other worlds. I can leave and seal the transmatter and that will be the end of it—if that is what you really wish. The choice is yours to make." He waved the gun at Patna. "Now open that door."

Bekrnatus stood, the ax dangling forgotten from his hand, the world he knew had changed, everything changed. Langli struggled his pack to one shoulder and waved Patna aside. He moved slowly towards the door.

"I will return and you can tell me your decision then."

Patna called to him as he went out, fighting down her loathing.

"The transmatter, when will we get to use it? To see the wonders of other worlds—"

"Never in your lifetime. Use of the MT is granted only when all the debts are paid." He had to say it because the sooner she faced the truth the better she would adjust. "And you will be occupied elsewise. Intelligent operators will be needed, not strong backs. Yours is

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the only womb from which intelligence may spring on this world. Keep it busy."

He hobbled away until he was clear of the buildings, then gratefully set the pack down. It was too much of a burden to take back to the transmatter. He triggered the Destruct and went on while it burned fiercely behind him. Expensive equipment, but it would go on the bill. They would choose to accept and pay, they really did not have much of a choice. It would be for their benefit. Not so much now, but in the long run. The two squat figures were still in the doorway looking after him and he turned quickly away.

What did they expect, charity? The universe was uncharitable. You had to pay for what you took from it. That was a natural law that could not be broken.

And he was doing his job, that was all.

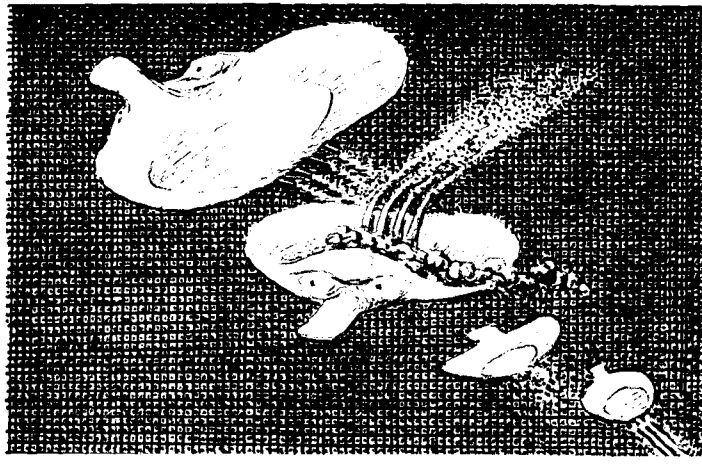
It was just a job.

He was helping them?

Wasn't he?

Stumbling, sweating and gasping, he hurried to be away from this place. ■

DEPARTMENT OF DIVERSE DATA



D. Pattee

Jet Propelled "Fork and Platter Bird" Avis Messator. E.T. from Spica IX. Has an insatiable appetite but is rather untidy in its habits. Does not fly very well, due to rarified atmosphere.

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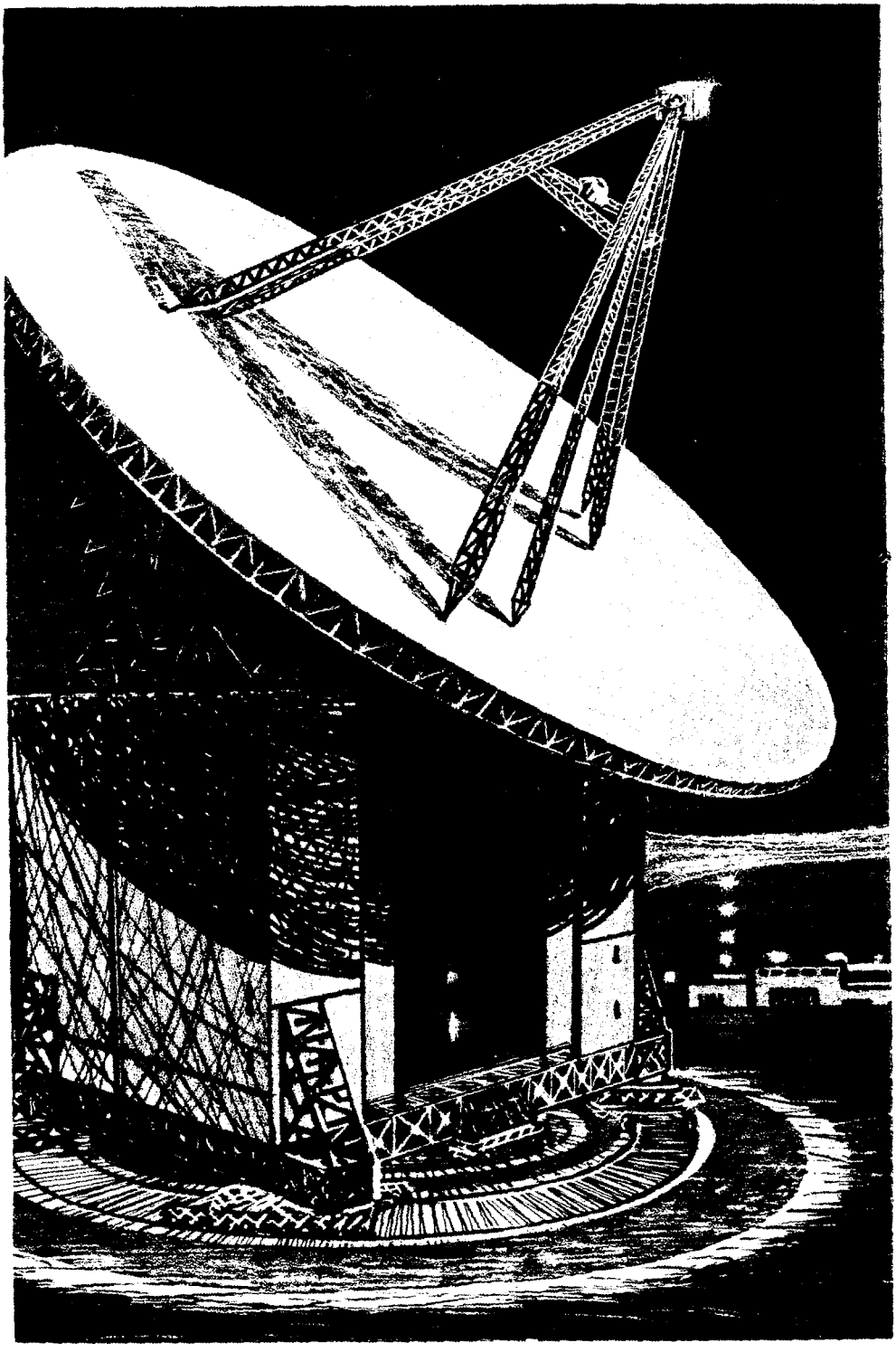

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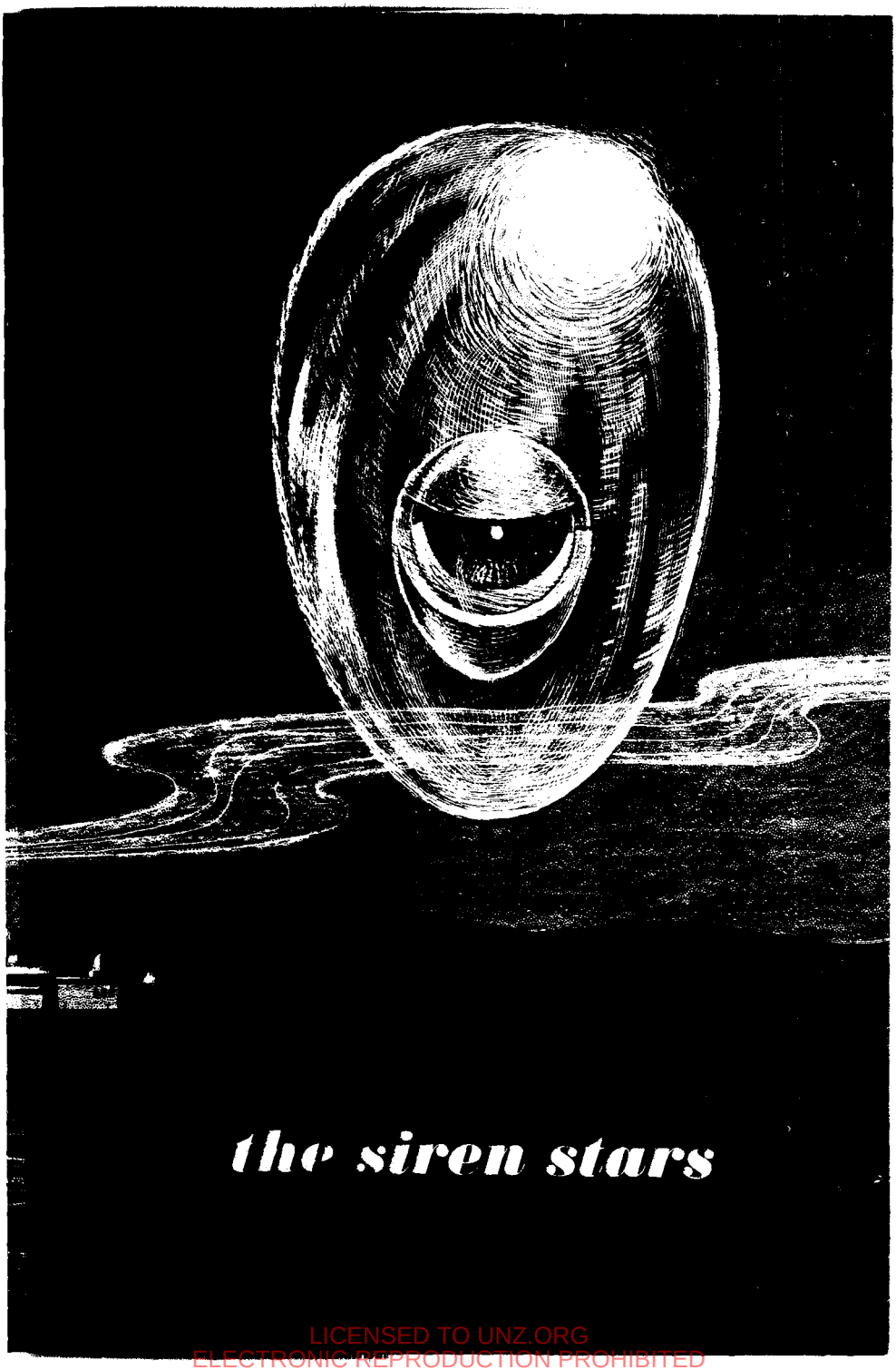

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Conclusion. The DNA used by all life on Earth to transfer information and spread its species might not be the only possible way of reproducing. Computers, for instance, don't handle information chemically . . .

RICHARD and NANCY CARRIGA

Illustrated by Kelly Freas

The contact had been made. Gregori Petrov was receiving messages from an extraterrestrial source. And it was the job of Science Processing, Inc. to find out exactly what the Russian astronomer was up to and report it to the President.

The job called for a scientist with a yen for adventure and more than his share of luck. Dr. Silverman, head of SPI, knew just the man for the job. John Leigh had a Ph.D. in Physics, he spoke Russian, and he was animal-smart enough to make his own luck when fortune seemed to frown.

So Leigh ended up at the giant radio telescope in Sunseek, New Mexico. Jan Van der Pool, the Dutch astronomer, was assigned to teach him all he could about radio astronomy. It promised to be a sticky job and when Leigh and the Van der Pools went to Juarez to relax they found themselves trapped high in the maze of a multistory parking garage by a gang determined to make that night their last. Leigh did fancy driving and with a wild leap from the second story in his Triumph brought his new friends out of the trap to safety.

When Van der Pool and Silverman judged him ready, Leigh was given a test of his skill in a "dry run" at Sunseek. He was to infiltrate an American installation and try to snatch the tape from the computer that was the twin of the one he'd have to take from the Russian machine. With the aid of a smoke bomb and a lot of bluff he grabbed the tape and brought it proudly back to his boss. But it was back to the books for Leigh. He had stolen the wrong tape!

Head swimming from Van der Pool's merciless drilling, Leigh was glad when Silverman called him back to SPI headquarters. He was even happier when he saw his new co-worker on the case. Professor

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Elizabeth C. Ashley was the university's answer to the drop-out problem. She was young, sun-tanned, and looked as if her dimensions had been worked out by a very well-programmed computer. Her equally spectacular brain did not show under the sun-streaked, coppery hair, but she had written a best seller about communications, had been an Oxford fellow, and was a leading specialist on non-human languages.

Leigh lost no time in getting better acquainted with his company's delicious consultant. They went to Dugan's Duck Coop on the beachside east of the Hamptons. It was a cozy place for a swim and dinner and the friendship mellowed fast on the sun-warmed sand. Their after-dinner stroll was rudely interrupted, however, by the appearance of three tough-looking characters apparently bent on the destruction of someone for one of them carried a machine gun. Leigh got Elizabeth back to the safety of his apartment only to be informed that her apartment had been robbed and burned.

What did Elizabeth know that had put her in such danger? Did the answer lie in the theories she had expressed at the last Dolphin Conference? There she had mused that the next step in Darwinian evolution might be to do away with biology completely. "Suppose," she had suggested, "the entity we reach in outer space is an intelligence in a completely mechanical form . . . neither benevolent nor malevolent but completely dispassionate. All a machine needs to establish itself here is the ability to send the plans of one of its members by some means and convince a member of our species to build it."

An interesting theory and Leigh would have liked to hear more, but Elizabeth was due in London for a conference. Leigh was to escort her to the airport, but at Jamaica Station in New York a free-lance cab proved to be a trap. The pair found themselves kidnapped. Leigh managed to escape but Elizabeth was caught again when she hesitated to follow him.

Silverman's rage at the loss of his consultant was chilling. And there were other developments. Aerial photos showed a new structure at the Russian installation. It was, Silverman concluded, the machine from outer space.

This news altered the objectives of the mission in Russia. Now Leigh had a three-fold task. First he had to neutralize anyone infected by the signal from the extra-terrestrial machine. Second, he had to destroy the machine itself. And third, he was to use the help of a bugged tape and a Russian computer programmer, Nina Popova, to alter the program Petrov had received from the star.

"Well," Leigh told Silverman ruefully, "when you plan a mission

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the American taxpayer certainly gets his money's worth."

Part 3

XII

Two and a half days later John Leigh lay with Nina Popova on a rise of ground at the edge of the woods surrounding the Soviet radio telescope. Nina reminded Leigh of an intelligent and high-strung field mouse. Her round, black eyes darted nervously through the underbrush and her little sharply-pointed nose seemed to be constantly sensing the air for a scent of danger. It was obvious that the life she had led as a spy for the last year had taken its toll of her nerves. She seemed on the edge of hysteria.

"There are no guards around the building," she was speaking hurriedly as she absently pulled a dry leaf to bits between her fingers. "They feel secure since the site is so well fenced. And it is almost impossible to get into the main computer building for both entrances are closely guarded. Every worker and scientist must be checked in at the main door."

They looked down onto the buildings. Nina tugged nervously at a lock of straight, mouse-colored hair hanging over one ear. "But I have a plan that will be possible for a strong and brave man. On the top of the building are some large ventilating fans. Do you see?"

Leigh nodded.

"You can enter the building through one of them," Nina continued. "Just below the ceiling there is a traveling crane. At night it is parked under the last vent at the far end of the building. It will cover your entrance through the vent and give you access to the floor." The pointed nose raised and quivered as some animal snapped a twig in the woods. "There's just one thing. At the bottom of the vents are large fans. You'll have to cut the wires to stop them or you will end up like the little birds who become too curious." The girl suppressed a wild giggle. Leigh looked at her questioningly. She sounded as if the thought of such a disastrous end to him amused her. Was she a double agent sent to trap him, or just a mouse afraid of the trap herself? Either way he was in her power.

"I have brought you a white laboratory coat and my badge. I could not get one with a man's picture on it. However no one ever looks at them once you pass the gate and besides," she made a face, "the likeness is not good. The rack for the badges is closely guarded and I shouldn't have taken mine from the building, but they do get lost sometimes." She gave a jerky shrug. "When you have completed whatever it is you want to do, I can hide you in my room perhaps

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for a brief time. Come back there and we will drink to your success, no?" Again Leigh heard the suppressed giggle and then the girl's whole body twitched as an unearthly squeal tore the air.

"That awful telescope! How glad I'll be to leave it forever." She glanced up at the red warning lights circling the giant dish that loomed to their left, then she rose and shook like a dog. "I must go before I am missed. My room is on the main floor of that gray barracks building behind the computer—the corner window nearest the telescope." She shoved the lab coat and badge at him and with a final, disorganized pulling and brushing of her dress and hair, circled away from him and was gone.

Leigh jumped himself as a few seconds later another shriek cut across the air. He decided to have a look. Moving through the trees to his left he soon came to the clearing for the great telescope. This giant cyclops was even larger than the one that had awed him so at Sunseek. It was six hundred fifty feet across. Instead of the airy structure of movable panels, like the New Mexican installation, the Russian dish had been built as one piece. It had taken a great amount of metal to obtain the structural rigidity this required. The two gantry towers necessary to hold it were like huge steel and concrete fortresses.

But most startling was the fact that this whole, immense structure of gantries and dish, four times heavier than its American counterpart, was mounted on a turntable much like that of a record player instead of the simple rails of the American design. It was the tortured metal turning in its ways as the telescope followed a star that caused the ear-splitting screech that filled the Siberian dusk.

The booms that extended out to the focal point of the parabola of the dish held an entire room in a gimbal arrangement rather than the conventional small receiver housing. Leigh could see, through its windows, a single scientist working in this room as it turned with the telescope across the sky. The dish was tracking slowly. Leigh looked at his watch and took the bearing of the telescope just as Van der Pool had taught him. Running down the list of one hundred candidate stars they had drawn up he realized that it was very possibly one several hundred light-years away.

"Pretty good," he thought. "Their receiver design techniques must really be advanced."

His curiosity satisfied, Leigh moved back to his vantage point above the buildings and took his bearings. The hubbub of activity around the hangar-like building was dying down as the supper hour approached. Even though it was late, the Siberian summer

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night was not dark, and Leigh longed for the cover of real darkness night had given him at Sunseek.

But at least he could see where he was going. At right angles to the computer building was the drab, solidly-built administration building. Here Petrov had his office. Probably he was working there now, unaware that, like the cat, he would soon have to pay an awful price for his curiosity. Leigh shuddered at the thought and pushed it away.

Next to the computer and behind the administration building lay the new translator building in a messy conglomeration of construction materials and equipment. On its farthest side, away from the other buildings, stood the liquid-gas tanks, their tiny vapor trails from the boil-off wafting aloft, silvery in the half-light. They were bigger than Leigh had ever seen. He shook his head. *What the devil are those for?* he puzzled. *I've got to find out before I leave here.*

Now it was as dark as it would get. Leigh tucked the badge and lab coat inside his loose, rough shirt along with the precious "bugged" tape and a thin, strong nylon rope. Slowly he made his way down the hill to the side of the computer away from the main door. From above he had seen just what he needed, a plumbing air vent pipe sticking up from the roof on that side. He formed the rope into a lariat and flung the noose over the pipe. Climbing quickly he was soon on the dewy arched roof. Cautiously he moved across the tarred surface. As he passed each one, Leigh could feel through his shoes the vibrations of the powerful fans inside the air vents. At last he got to the one under which Nina had said the crane would be parked.

The vent was larger than it had appeared from the hill. From the roof to the top of the arch, where it turned over on itself to keep the rain and snow out, it was a good ten feet tall. Leigh could feel the blast of hot air from the fan as he stood under the open end of the vent. The galvanized sides looked quite impassable and Leigh crouched on his heels pondering the solution. Nearby was another air pipe for the plumbing. He tied the end of his rope to this and tested its strength. Satisfied that it seemed firm, Leigh looped the free end of the rope around his wrist and stood directly under the opening of the vent.

He looked up into the inhospitably smooth inside. The edge of the metal had been rolled around a bar to give it strength. It was the only foothold he could see. It would have to do. He chinned himself on the bar and managed to get one foot up to the five-inch projection. With a heave of his body he pulled himself up into the

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opening and, spread-eagling his legs against the sides, peered over and down into the vertical section of the vent.

The dust and hot air made his eyes smart, but he didn't want to believe what he saw anyway. Women, he concluded bitterly, had a remarkable ability to gloss over the difficulties in any project. Below, waiting to cut him into so much sausage meat, was a huge fan, about four feet across. Worse yet, he could see that the wires to its motor were on the inside of the building. With a resigned sigh, he felt inside the shirt for his wire cutters and tied the rope more securely around his right wrist. He knew his injured left shoulder could not take the strain of what he had in mind. *God, I wish I were left-handed,* he thought, heisting the wire clippers unfamiliarly in his left hand.

Here goes.

He flung his body over the greasy arch of the inside of the vent and felt a moment of sheer terror as his body dropped five feet straight down towards the whirling steel blades. Then the rope held and he felt a cruel jerk on his right arm. He was hanging like a fly in a web a foot and a half over the fan. Bracing his feet against the slimy walls of the vent, he leaned down and sliped his bare left arm between the deadly edges of the fan and the walls of the vent. He stretched agonizingly. The wire cutters would just barely reach their vital target.

He stretched still farther and in doing so jerked his arm just a trifle. It was enough. He felt his stomach turn over as the fan blade grazed his forearm and drew the thinnest line of blood. Then he found the wire and braced himself for the shock. *Now.* The shock was mild, but hanging almost upside down in the vent, it was enough to make him dizzy for a moment and he clung gratefully to the rope and watched below. First the silver-gray disk of the spinning fan became a whirl of discernible blades, then he could see all four blades like the steel petals of a deadly flower.

The blast of hot air became less and less until finally he judged it safe to reach down and stop the slowly-spinning fan with his hand. Bracing again against the walls of the vent, he untied the rope from his wrist and with all his might, threw it up and out of the vent. *By the time someone goes scrambling around on the roof, I hope I'll be out of here,* he said to himself, as he quietly lowered himself through the blades onto the top of the crane. *At least Popova was right about the crane,* he admitted as he climbed down from his perch onto the catwalk.

From his shirt he drew the lab coat, put it on, and pinned the badge under the collar so that

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Nina's unflattering likeness was covered.

He chuckled to himself as he slipped into the rumpled, soiled coat. *Looks like they wear dirty lab coats here, too. Don't want to look too clean or they'll think you haven't been working.* He looked over the catwalk at the activity below him.

The main computer occupied the center of the floor. It consisted of a console, perhaps twenty feet long, with four operators seated at it. Two of these were adjusting knobs and watching the flickering green lines on an oscilloscope screen. The other two were talking through small headsets and flipping switches. The console itself was covered with an array of changing lights.

In front of these four men and just beyond the console was a model of the telescope about ten feet tall encased in a clear plexiglass dome dotted with tiny lights. The model inside was moving slowly. *Now that's really something,* Leigh admitted appreciately as he gazed at the working, synchronized model of the telescope with model stars fixed to the dome above it. *Beautiful!*

On the other side of the model, elevated above the floor, was another console enclosed in glass and manned by a single operator who seemed to notice everything that went on on the floor. Leigh rightly guessed that he was the chief operator.

Around this enclave were row after row of computer racks and magnetic tape units. About a dozen people bustled around these loading and unloading them and doing various service operations. Off to one side were several smaller computers also working busily, and farther down Leigh could see his goal, the tape library. He watched with interest the activity there. A man and a woman were checking the tapes in and out of the rows of cabinets filled with magnetic tapes in slots. People would request tapes from these two. They would find the proper one and hand it to the borrower, who would take it over to the computer and after it was used, bring it back and give it to one of the librarians to be refiled. Unless there was some code word he could not hear from his perch on the catwalk, Leigh was relieved to notice that no identification seemed to be required.

Away from all this activity, Leigh noticed a new area under construction. It was alive with carpenters, plasterers, and electricians. A great bundle of black cables already snaked its way across the area and then out through a special hole cut in the wall. From its direction Leigh realized that this was the link to the new building outside. From the pace of the work, he concluded that the completion of the link must have been

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given highest priority. Leigh watched the activity a few seconds more to get his bearing firmly in mind and then made his way casually down the catwalk ladder and strolled onto the floor of the computer. No one seemed to notice him. The place, except for the construction area, was not well lit and everyone seemed intent on his own affairs. He put the "bugged" tape under his arm and walked slowly to the tape library. Suddenly his heart skipped a beat. Someone was tapping him on the shoulder. He forced himself to turn slowly. "Yes?" he said in Russian. A large, friendly-looking Slav in the dress of a carpenter was grinning at him. Had he seen him come down the ladder?

"Comrade, you look like you know this place well. Me, I'm not used to it. I build houses in town and at reasonable hours, too. Here it's twelve hours a day. Ah, I know," he raised a hand to still Leigh's objections. "I know you scientists work fourteen. But you understand these toys. They are yours to play with. For us it is Siberia and the same dull hammer and nails." He shrugged expressively. "Ah, well, such talk will never get me back to Moscow. What I want to know is, how do I get back to the work area? Never do I leave for my supper but I cannot find my way back."

Leigh managed a benevolent smile and directed the fellow back to his work. *Ah, they're alike all over the world. He thinks the scientist's life is all fun and games, while he slaves at a job. I suppose to some extent he's right, but,* he remembered the weary days and sleepless nights of study and the grit of fatigue in his eyes, *it's a wearing game all the same.*

Now he found himself at the tape checkout desk. The librarian who came to the counter was a pleasant-looking, rather husky blonde with a dazzling smile that she flashed at the boyish face before her. "May I help you?"

Leigh returned the smile. "Why, yes, I need . . ." and he named the monitor tape for which he had the duplicate. The girl produced the tape quickly and handed it to Leigh without question. He thanked her and started toward the computer. He walked several paces and then stopped as if he had suddenly remembered something. Turning on his heel, he returned to the blonde at the checkout desk. "I'm terribly sorry. We won't be able to use that one tonight after all." He slid the "bugged" tape across the counter and looked at her with an apologetic expression on his face. "I had forgotten that I had to work with this one." He held up the one he had just taken from her. "I'm sorry."

"Not at all," the girl smiled brightly. Then she paused. "Aren't you new around here?"

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"Yes," Leigh admitted truthfully. "I hope I shall learn my way around better soon."

"Any time I can assist you," the blonde leaned over the counter, "please let me know."

"Of course," Leigh answered and with parting smiles, he turned away to attack the problem of getting back to Nina.

The vent was useless, for he had thrown away the rope and there was, besides, no telling when the broken fan would be noticed. But he remembered the air vent for plumbing he had used to tie his rope to. A vent pipe meant that there was a toilet somewhere underneath and that meant privacy and a chance to get out of a window. He made his way in the direction of the parked crane.

He had just made out, in the far corner of the building, a walled-off area with a door marked "Toilet" when he nearly collided with another Slav, as large and burly as the carpenter but with the flushed face and rheumy eyes of the habitual drunk. The man wove uncertainly on his feet for a moment and then focused on the slightly smaller man in front of him.

"Ah, comrade," he slurred the word slightly, "it is a wonderful thing you scientists have built here, a wonderful thing. A credit to the state." Leigh gave him a perfunctory smile and made as if to pass. "I only wish," the man continued, "that I could understand it. Now the telephone, that I understand." He nodded sagely. "There is a little wire. Voice travels upon this little wire. Perfectly clear. But radio. Where is little wire?" He grabbed the front of Leigh's white lab coat. To John's horror he realized that the man had uncovered his badge and the unflattering but distinctly female likeness of Nina Popova stared out at the world.

"It's like that light up there," Leigh said quickly and pointed to the fixtures above. "The light is up in the ceiling and you can see it, but there's no wire from there to your eyes, is there?"

The Slav stared intently at the ceiling and shook his head slowly. "Quite right," he muttered, "Quite right. No wire to eyes." He stood staring solemnly at the ceiling, while John slipped past him and readjusted his collar to cover the incriminating picture. "But the fan," he heard the man say. "The fan has stopped. Must be fixed or the boss will be angry."

He lurched slightly and marched purposefully toward the ladder to the catwalk.

Leigh forced himself to walk slowly towards the toilet and once inside shut and locked the door. High in the wall was the window he had been hoping for. Quickly he threw it open and was over the sill and onto the ground. He made for the woods and a crevice in the clearing he had picked out earlier.

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Far into this hole he shoved the tape with its deadly information and stuffed the opening full of pine needles and dead leaves. Then he removed his lab coat and badge and circled to the window of Nina's room. At his signal, the girl opened the window and pulled him inside.

Gratefully he accepted the glass of vodka she shoved in his hand. He saw that she had already been toasting his good luck. The bottle was partly empty and the lady's clothes were much askew. "To success," she giggled and tossed off her glass. "To success," he repeated and felt the warmth in his stomach as the vodka hit bottom. The drink tasted great and he knew he'd earned it. Step one of the mission had gone off without a hitch.

XIII

They had another toast to Nina's safe escape and one to the latest Soviet Moon probe. And, of course, one to the latest NASA success, just to be fair. It looked as if Nina was in the mood to go all the way back to the first Sputnik and drink to every space advance on both sides of the Iron Curtain. Under other circumstances, it might not have been such a bad idea, but Leigh still knew where he was and what he still had to do. He fought off the relaxing effect of the alcohol and firmly set Nina's glass on the table.

"Now, young lady," he said sternly, "there will be plenty of time for toasts when we are all safe. Right now I have to find the astronomer Gregori Petrov. Do you know where he is?"

"Petrov? Yes, he is now the director of the laboratory. He is a very important man here. Has a big office on the main floor of the administration building with many secretaries."

"Where does he sleep at night? I need to see him now."

"Oh, he will be in his office. Lately he almost never leaves it."

"In the administration building?"

"Yes, but not in the big office. A few weeks ago he had a little hideaway built off of a back corridor on the second floor. He stays there almost all the time now, and it's worth one's job to interrupt him unnecessarily. His light burns late into the night and they say he sleeps there when he sleeps at all."

"Good. When does this place start to quiet down for the night?"

"About midnight. The last shift goes off work then."

Leigh glanced at his watch. "About two hours to wait. Is there any safe place you can hide me until then?"

"Yes," she gave the nervous giggle again. "In my bed. You must take off your clothes and get in. The hall guard will be checking soon."

John looked at her question-

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ingly. "Do not be prudish," the girl snapped crossly. "They will think you are Josef. You will be quite safe, only do hurry." To his surprise she slipped out of her skirt, threw it on the chair and began pulling hastily at the buttons of her blouse. "Quickly," she urged nervously, "we must not be caught."

With a shrug Leigh followed suit and began to undress and put his clothes on the chair with hers. The girl was impatiently standing by the narrow bed waiting for him to crawl in next to the wall. For a mouse, she had quite a satisfactory figure. She had let the mousy hair down and it fell in a soft, clean-smelling cape around her creamy shoulders. She caught his stare and her black eyes snapped. "Will you get into bed?" she commanded.

John did as he was told and climbed between the rough, cold sheets. To his surprise he felt the warmth of the Russian girl pressed against him.

"Now you're quite safe," she whispered. She snuggled closer. "You're even almost the same size as Josef."

"Who's Josef?"

"My lover. He's a mathematician. Tonight he is leaving here, too. We plan to meet in Las Vegas when you get me out of here."

"Las Vegas? Why do you want to meet in Las Vegas?"

"To become rich. Josef, you see, is a genius. He learned about gambling from an American friend he met at school. For several years he has worked on a system to make much money in the casino. Now it is perfected. All we need is freedom and much money to get a . . . what do you call it? . . . a stake. You will get me the first and your kind employer will supply the second. Do you see?" She gave her nervous giggle again.

"Did Josef come here often?"

"Ah, yes," she sighed, "quite often. The hall guard is used to seeing him where you are now. There is one thing. When she opens the door, you must . . . er . . . act as if we are making love. She has a lover herself, one of the carpenters from Moscow. She is nosy, but she will not think of interrupting. Do you understand?"

John could no longer suppress a chuckle. "Perfectly," he laughed. "It's all in the line of duty."

To his surprise, the girl bristled. "Do you find the thought of making love to me humorous?"

John quickly sobered himself and hugged the girl playfully.

With a happy, slightly tipsy-sounding sigh, Nina snuggled close in his embrace.

It's all in the line of duty, John reminded himself again.

Then he felt the girl's body stiffen. "She's coming," Nina whispered in his ear, "I hear her footsteps in the hall. Quickly, do as I told you."

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"Tell mother I died game," Leigh muttered in English under his breath.

"What?"

"Only an old Army expression," he explained.

The door opened and a shaft of light fell upon the bed and a very cozy scene. "Nina?" a deep woman's voice asked.

"Yes. Go away." Nina's muffled voice answered crossly.

Leigh could hear the smile in the voice as it answered, "Good evening, Josef. A fine evening, no?"

John grumbled an unintelligible reply and the door closed on the sound of the guard's lewd laughter.

Leigh heard the girl sigh softly. He felt her body relax.

An hour later he roused himself and reluctantly drew away from the warmth of the sleeping girl and the rough sheets, and began to dress for the night's work. Almost without warning the door to the room flew open and someone switched on the lights to reveal the pride of Science Processing in the helpless position of one leg in and one leg out of his trousers. Nina sat bolt upright in the bed and her eyes widened in terror at the sight she saw over Leigh's shoulder.

John struggled into his pants and turned to follow her stricken gaze. The two security guards standing in the doorway had the stolid, muscular respectability of policemen all over the world. But it was the man standing between them that held Nina's eyes like a mouse watching helplessly the advance of a deadly snake. And the man was not a pretty sight.

Never before had Leigh seen so horribly scarred a face or so clumsy a job of plastic surgery to repair it. The patch that covered one eye did not hide the badly scarred cheek underneath it. The other eye must have been damaged as well for the flesh around it showed signs of plastic repair. One arm was amputated near the elbow and the hand had been replaced with a metallic prosthetic device that surely must have been unique—it ended in a small, wicked-looking knife, instead of the usual hook. The man was dressed in the best of Russian tailoring but it could not hide the strange stance that suggested to Leigh that one leg was also missing and the man was probably using a false one.

"Miss Popova and a friend. May I ask whom I have the pleasure of addressing?"

Nina answered quickly, "This is Josef Vulkovich. We have an understanding." She looked down and toyed with the edge of the sheet.

"I was addressing the gentleman, Miss Popova."

"And you heard the lady, I believe." John answered in Russian.

"Quite so," the man replied, "but unfortunately one cannot always trust women to tell the truth,

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You see we have a gentleman who claims to be Josef Vulkovich in custody right now. Someone made an unauthorized entry into the computer this evening and Comrade Vulkovich was apprehended dressed for traveling with a number of papers in his possession. He has been arrested as a spy." John heard the girl behind him gasp and then begin to whimper. "We knew of his 'understanding' with Miss Popova and thought perhaps she would explain his activities to us.

"So you see, I find it necessary to address my question to you again. And this time I suggest the truth. Who are you?"

John stood silent. The room was quiet except for the soft whimpering of the frightened girl.

"Well then, perhaps we shall have to ask Miss Popova after all." The man advanced slowly toward the bed. Her black eyes utterly held by his, Nina pulled the sheet up to her chin and stared helplessly. "Will you be so good as to stand up, Miss Popova?"

"But my clothes . . ." the girl objected.

"Stand up!" The man abruptly dropped his elaborate politeness. "Do you not realize that you are accused of consorting with a spy? Answer me! Who is this man?"

The girl's fright left her completely tongue-tied. She stood by the bed, her body shivering with terror and cold. She looked more than ever like a trapped animal.

"She is only guilty of loose morals. You need not shout at her." John interrupted, hoping to attract the man's attention away from her again.

The man did not even look at Leigh but spoke over his shoulder to the two guards. "Keep that man under control. He will be dealt with later." John felt his arms pinned behind him as the bulky bodies of the guards closed in on each side.

"Now, Comrade Popova, I am waiting." He waved the knife menacingly in front of the girl's face. She shook uncontrollably. "Still no answer?" John winced as he saw the man draw the knife across the girl's cheek and a pencil-thin line of blood appeared.

Suddenly the girl broke and dashed toward the door in sheer panic. The man raised his knife arm. There was a report, a puff of smoke, and the girl lay dead almost at John's feet. Leigh looked sadly at the girl's crumpled body. "Nina, I'm sorry," he said softly to ears that could no longer hear.

The man glanced only a moment at the dead girl and then limped across the small room until he was face to face with Leigh. "Now then, we shall have to find out who you are." Leigh could see the twisted mind that glinted behind the scarred face and mutilated body. The malevolence of the man was almost a tangible thing that

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filled the room with evil. Leigh could feel even the bodies of the guards holding him tense as he drew nearer to them.

"You understand, of course, that in the light of Vulkovich's arrest, the unauthorized entry into the computer, and the discovery of you with Vulkovich's mistress, it is absolutely necessary that we find out who you are and what you are doing here.

"I feel that I have seen your face in the files of known American espionage agents, and that the name and record will be easy to check. However, that will take time and I prefer that you tell me yourself. Are you ready to speak?"

The man paused and John stared stonily back into his ugly face.

"Of course it is naïve to assume that you will speak without some sort of persuasion if you are a foreign agent. But fortunately I am an expert in the field of persuasion, and if necessary something can be arranged for you that will make you only too happy to chat with me. Or do you wish to begin our conversation under more pleasant circumstances?"

The man waited expectantly and John felt the guards tighten the twist on his arms.

"Still silent? Then I beg of you to excuse me while I go to my car and fetch some friends of mine who are excellent 'ice-breakers'." He snarled at the guards. "Tie him to that chair by the table and bind his right arm loosely to the table. If he resists, shoot him."

The man limped past them with a contemptuous glance at the still body of the girl. The guards pushed Leigh into the chair and began to speak in Russian, apparently forgetting that Leigh knew the language.

"Bonsov seems in a fouler mood than usual tonight. Did you see the look on his face when he shot the girl?"

"Yes. It was terrible. I think the man's mad. They say it's the pain of his injuries that makes him so."

"All the same, I'm glad I'm not in this man's shoes, whoever he is. He'd be better off if we shot him than have him meet Bonsov's friends." John saw the man shudder.

"Quiet. He's coming back. I'll be glad when this is over."

The man, Bonsov, appeared again at the door with two small containers about the size of shoe boxes in his arm. He set them on the table and tested the rope tying Leigh to the chair. Then he tested the one tying him to the table. "This is too tight. I prefer that his arm move a bit. It makes my friends more persuasive when they have a moving target.

"Now fix the light so that we can see this man's face properly. That's right. Directly into the eyes."

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Bonsov opened the first box and removed from it a long gauze sleeve with a cuff of heavy elastic at one end. He reached over and with his knife, slit the sleeve of Leigh's shirt up to the shoulder. He slipped the gauze sleeve under the loosely fitting rope and pulled the elastic over his exposed arm until it fitted snuggly above John's elbow.

Leigh watched the proceedings with what he hoped appeared to be detached curiosity. In reality, his stomach was churning with fear of what was to come. Tales of the sadistic tortures of the Russian secret police were classics in the history of man's inhumanity to man and they were often administered by men like this, chosen for their jobs because of their love of human suffering and pain.

"You, no doubt, know of the more common measures of persuasion. As you can see, many of them were tried on me by our mutual enemy during the last world war, and I know them to be unpleasant." Bonsov's face became, if possible, even more cruel with the memory. "But the worst thing I experienced during my interrogation was not knowing what they would do next. It was this fear of the unknown that finally broke me, as it can almost any man.

"Therefore, I spend my spare time devising new and unique methods of persuasion. My little friends here are the result of this hobby." Here he patted the second shoe box. When he did so, an angry buzzing noise filled the room and the guards seemed to shrink back in terror. Leigh knew the truth of the man's argument. It was the uncertainty of what would come next that brought the beads of perspiration to his forehead.

"These are, of course, just bees," Bonsov continued. "Perhaps 'just bees' is not correct, for they are really *the* bees—dreaded African bees from Brazil. Let me tell you their story. Some years ago a Brazilian beekeeper decided to import some of these bees to his country for in spite of their known ferocity they were eager workers and produced about thirty percent more honey than the European varieties he had been raising. He planned, by cross-breeding, to breed away their evil dispositions and hopefully retain their industrious nature. Unfortunately his plans backfired and instead the new breed proved even more vitriolic than their parents. They are killers. They have left in their wake dead birds, dogs, horses, and several humans. They make fine pets for a person in my position, wouldn't you say?"

All the while Bonsov was speaking, he was striking the box with the dull side of his knife hand so that the bees were nearly beside themselves with rage. The buzzing from the box filed the whole room and Leigh saw the big guards

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watching it with horrified fascination.

Bonsov took the free end of the sleeve and sliped it over the end of the shoe box, securing it with a heavy rubber band.

"Now pe.haps you will tell us who you are and what your business is here before I release my friends. No? I thought not."

The man raised a gate in the box and five or six large bees flew into the sock and crawled under the loose rope tying Leigh's arm to the table. He braced himself for the pain, but nothing had prepared him for the nerve-wrenching shock of the first stings. They made the hornet stings of his youth feel like mosquito bites. He writhed in pain and spat out all of the Russian swear words he could remember at his captor.

"That is not what I asked you," Bonsov replied calmly and released more bees. Now Leigh could no longer feel each sting. His whole arm was a throbbing mass of flaming bites. But finally Bonsov raised the gate and left it up. All the bees were swarming angrily in the gauze sock. This was what Leigh had been waiting for. With a quick wrench he pulled his arm sideways under the loose rope and jerking his arm up quickly, ripped the gauze wide open, releasing the bees into the small room.

It was utter chaos. The guards, already suspicious of the bees, forgot their prisoner completely and, shouting wildly, ran for the door. Bonsov, perhaps because he knew the nature of the insects better than they did, was panic-struck. Because of his ruined leg and arm he could move only with deliberation. When he tried to run, he fell over Nina's still form and crashed to the floor where he lay, helplessly commanding the guards to return to his aid.

Leigh smiled grimly as he hobbled to the window, flung it open with his aching, but free, right arm and threw himself out, the wooden chair hitch-hiking behind. He heard the splinter of wood as his fall broke the chair and released his feet. He ran as fast as he could toward the woods. There he freed himself and sat down to catch his breath and literally lick his wounds.

A confused babble from the dormitory floated out on the night air as the bees invaded the rooms. It would keep them busy for a while but he knew that soon someone would collect his wits and try to find him.

Quickly he circled the buildings to the back of the administration building where, on the second floor, he could see one lone light shining into the night. Petrov's hideaway!

He found a window he could reach with his damaged arms and, with a leg salvaged from the chair, knocked out the glass and crawled

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in. He followed the hallway to a flight of stairs and doubled back on the second floor to where he had seen the light. The room was at the end of a small, blind corridor. He could see the pencil-thin line of light etched under the door. To his surprise he could hear the soft murmur of voices.

Leigh moved soundlessly down the corridor and put his ear to the door. Even more surprising, he now realized that the sonorous male voice was speaking in halting English.

". . . And after I established that the signal did not come from natural sources, I set about translating it. The code was very easy to break, being based on a mathematically pristine rhythm. You cannot imagine the thrill it was to see the perfection, the beauty of this message. The small sample was such that I knew at last that all the answers to humanity's problems could be gained from this source. The translator will soon be finished. Soon I shall know these answers. You must not be allowed to stop so great a dream."

"But you must understand, Dr. Petrov, that this beauty is a trap. Unless the knowledge you possess is handled with great wisdom, it will destroy human society. Humanity will need many years to find ways to use these answers safely. You cannot just throw them into the system all at once. I must convince you that this perfection is dangerous and that the work of many men from many nations will be necessary before it can be made safe."

Leigh leaned against the wall until the line of light under the door stopped swimming in front of his eyes. The last voice was a woman's and he was wildly glad to hear it, for it belonged to Elizabeth C. Ashley.

XIV

Leigh crouched closer to the door and gently tried the handle. It turned slowly and noiselessly. The door was not locked. Through the tiny crack he could see the tall, intent figure of the Russian scientist. Petrov was about forty-five, with sandy hair combed straight back from a wide forehead. His face was remarkably handsome with intelligent dark eyes, a straight nose, and rather full lips. Even with the sedentary life his work must require, he seemed fit and muscular, probably through some careful routine of exercise. His voice had the firmness and power of a man used to being in charge of the situation. He looked, in short, every inch the top-flight scientist-administrator, a rare and valuable bird. Leigh wished regretfully that they could have met under different circumstances. The man spoke again.

"Yours, my dear professor, is a typically bourgeois attitude. There

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are always such objections to progress. In reality, one highly-trained and intelligent man can work more efficiently than all the nation-proud groups in the world. I have proved that, have I not?"

"What do you mean?"

"Let me tell you the story of the signal. Then you will understand.

"To begin with, searching for such a signal was a sideline with me. Governments are too short-sighted as a rule to spend large sums of money on so," he groped for the word, "esoteric a project. So in order to earn his keep, the scientist must engage himself in something more obviously to the government's immediate advantage like defense, or a cancer cure.

"You can imagine my surprise, then, when what is almost a hobby to me yields results so spectacular—the first reception on Earth of a signal from another civilization separate from ours by aeons of time and space.

"The signal has a peculiar form. First are passages fifty minutes long that are a hopeless muddle—almost like static. Then there is a five-minute interlude that is always repeated. It begins by going through a steady dot-dash sequence and then gradually becomes more complicated. I realize that it is a type of learning code to show me that the signal is not natural and to teach me how the translation is done.

"There are two surprises in the little preamble. The first is a statement that simple instructions concerning the design of a translator will appear once in every two thousand cycles of the fifty-five minute pattern. The message instructs me to wait for that, then to proceed to build the translator. The second surprise is more remarkable. It suggests that the agency receiving the message remain quiet about its contents until the translator is complete, apparently a defense against thinking such as yours.

"I study the message for several days, telling no one of my discovery. Several months might pass before the plans for the decoder are transmitted, and I know that the government will want some sort of report on the use of the time I am allotted on the telescope. I decided to tell them that I think I have indeed received a signal, but that the whole thing is such a muddle that I need to build an enormous decoder to decipher it.

"Of course the bureaucracy wants to bring other experts in right away and newsmen also. I counter the former nuisance by telling each research group that another group is assigned to the job and then I swear each to secrecy on pain of the government's wrath. Newsmen I quiet by saying that the whole thing might be a fluke and we do not wish the Soviet government made fools of before the whole world. The scheme works

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beautifully, for, as I told you, a single exceptional man can outwit a pack of fools.

"In time the message containing the plans for the translator is received. Essentially it describes, in a string of logical statements, an enormous digital computer. The circuits are very complicated. Even I can make no sense of them. But I have engineers start building the machine. The instructions are mostly about circuitry, but there are also a few specific details about hardware. For instance, the memory required is so large that the signal directs the builders to use superconducting materials for it. We had to pipe in large amounts of liquid helium and nitrogen for that. The translator also has its own fuel cell system for emergency power. It uses liquid hydrogen and oxygen—a tricky combination and hard to come by especially here in Siberia. But this fixes it so none of the transmission is lost even in a serious breakdown. The machine also has some ten features I don't completely understand . . ."

The scientist's voice had taken on a completely absorbed tone. Leigh had heard it often when some of his friends would explain a particularly exciting phase of some discovery they had made. At such a time, the scientists seemed to be talking more to themselves than their listeners, holding their discovery up to the light to be pondered and adored as a work of art, and not really caring whether their audience could follow their reasoning or not.

Petrov paused in his narration and thought about the mysterious ten features that puzzled him. John could now see through the crack that Elizabeth was seated in a chair near his desk. She sat very still and Leigh realized that her hands and feet were manacled with a type of handcuff. Her brown eyes were alert, but bloodshot with fatigue. Otherwise she seemed unharmed. Suddenly she stirred to gain a more comfortable position on the hard, wooden chair. The movement brought Petrov back to the present.

"But I bore you. You are, after all, a philosopher and not a scientist or engineer. You are probably wondering why you are here. The answer is, of course, obvious.

"Your remarks at the Dolphin conference reached my ears through a colleague who is as impressed by your undeniably attractive looks as by your theories. I realize how dangerous such talk as yours can be to my work, no matter how silly your ideas are, and decide to take steps to protect the installation. I think it is hard to convince the government that such measures are necessary, but counterespionage appeals to them much more than a message from outer space. They embark with enthusiasm upon their game of what

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I believe your children call 'Cowboys and Indians.'

"First they have orders to attempt to destroy the installation at Sunseek in the United States and key astronomers connected with it. Then they are to remove you completely from the scene. You are, I believe, subjected to a number of accidents from which you fortunately escape."

"My car, and the night on the beach, and the fire in my apartment? But if you tried so hard, why do you say 'fortunately'? It sounds as if you very much wanted me dead."

"So I think at first. But then a better idea occurs to me. Instead of killing you, I have decided to convert you."

Elizabeth's expression changed at that moment from one of polite, rather detached interest to one of horror. She seemed to shrink back in her chair as Petrov reached into the drawer of his desk and removed a sheaf of papers.

"You remember the little preamble to the message cycle I have mentioned?" Petrov continued. "All of it was very easy to decode. After the instructions about the reception of the signal and the translator, the message becomes indescribably beautiful. It is hard to say how I can know that something from another time, another place, another civilization is beautiful, but I do. Perhaps beauty is the Rosetta stone by which we shall all communicate after all." The astronomer's voice was becoming gentle, almost dreamy. John found himself listening intently. "Let me try to explain. As a scientist I saw beauty, with astounding clarity, when the message unlocked the deepest secrets of the natural universe in a few perfect statements.

"As a philosopher you will see beauty in the clarity with which the message reveals the inner truths of the soul and the total search for knowledge. And I am certain that an artist would appreciate the exquisite cadence and the gentle lilt of the message itself—an almost musical rhythm like the greatest of ancient ballads but surpassing them in purity of form.

"But I shall tell you no more. It is time for you to see for yourself. Here is the translation of the message. I typed it myself. Now you will be the second person to hear the golden message from another world. Read!"

He thrust the document in front of the girl's face. She pulled her head aside and shut her eyes. "No, no," she murmured softly. "I won't. You have been trapped. It is I who must convince you."

"Read!"

"That's enough, Comrade Petrov."

The Russian's reaction to Leigh's unannounced entry into his office was surprisingly quick. He

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snatched a small pistol from the drawer and had it pointed at Leigh's chest before the American agent was halfway across the small room. The action had the effect of creating a grotesque tableau. The tall Russian pointing the gun at a man with a ripped sleeve showing an arm painfully swollen with some kind of stings and the handcuffed woman staring in amazement at them both. It was an impasse.

Finally Elizabeth found her voice. "John, what are you doing he-e?"

"If you two know each other," Petrov said icily, "perhaps you would be kind enough to introduce me. I dislike interruptions, especially by strangers."

"Dr. Petrov, this is Dr. John Leigh of the American scientific abstracting service, Science Processing, Inc." Elizabeth made the formal, absurd introduction.

"Ah, yes. I believe this gentleman's activities have come to my attention. He was, I understand, instrumental in protecting you from the clumsy efforts of some of our espionage people. I am grateful to him for saving your life. Sit down, Dr. Leigh."

Petrov motioned with the gun to the only remaining chair in the room. When John was seated, the astronomer continued.

"You have, from all reports, taken quite an active interest in my work here. I assume, therefore, that you are aware of its nature. You probably heard while you listened outside the door—as I assume you were since your entrance is so dramatically timed—that I propose to convert this rather stubborn woman to my point of view. She refuses to read the message, however, so instead I shall appeal to you. From your dossier, I know that you are trained as a scientist. Perhaps you are better equipped to understand the beauty of the document." He took the paper from Elizabeth's manacled hands. "You are being allowed a great privilege. You will be the second person on Earth to read it."

John took the paper from the Russian's hands and his eyes traveled to the cover page. It had the standard form of a scientific paper. REPORT ON THE FIRST KNOWN RECEPTION OF AN EXTRATERRESTRIAL RADIO SIGNAL FROM AN INTELLIGENT SOURCE, by G. L. Petrov. John flipped the page and started to read. He was only vaguely aware of Elizabeth's voice whispering in despair. "No, no, John. Don't read it." The first several lines seemed quite innocuous. Then Leigh became aware of a strange melody to the words. Deep in his mind something stirred, a new quality, a feeling he had never before experienced. His whole being felt drawn to the message, to read on, to drink fully from this fountain of truth. Then Elizabeth's

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voice came through to his consciousness, soft but persuasive. "John, please don't read it. Please!" With all the strength he had left he wrenched his eyes from the lines of close type and tore the manuscript into a hundred pieces.

Petrov was completely enraged. He dropped the gun and lunged at Leigh, snatching for his precious paper, trying to save it from destruction. Ordinarily John would have had a chance for, though he was not as tall as the astronomer, he was more powerfully built. But the effect of the gunshot wound, the bee stings, and lack of sleep began to tell and John knew he was losing the struggle.

Petrov had him down on the floor, trying to squeeze the breath from his throat when Elizabeth's clear voice cut through the room speaking precise, slow Russian.

"Stop where you are, Dr. Petrov."

Petrov looked up in surprise. The woman held the pistol remarkably still in steady hands. In spite of her handcuffs she had managed to reach the gun and unnoticed by the fighting men had picked it up. "Please get up."

Petrov rose to his feet and John stood beside him. The Russian spoke pleadingly. "You must let the signal be received. Think of it. All of truth known at last in one moment. Who knows what rewards a grateful world will bestow on such benefactors as we. Here, the report is ruined, but let me tell you what it says. I have memorized its every word." He took a deep breath and repeated the words John had read in the report.

With cold deliberation, Elizabeth squeezed the trigger. Petrov looked at her and shook his head slowly from side to side. "You are a fool," he muttered and crashed to the floor. Her aim was excellent. The man was dead with a bullet through his heart.

John gathered up the fragments of the report, placed them in the metal wastebasket, and set them afire. He and the philosopher watched as they burned to black, curling ashes.

Elizabeth turned to Leigh. He noticed with surprise that she held the still-warm gun and that it was pointed at him with the same unwavering sureness with which she had trained it on Petrov. "I must know the truth, John. How much of the report had you read? Were you to the heart of it yet?"

"No. I had read only as far as the segment Petrov recited."

The gun dropped to the floor with a clatter as Elizabeth sank into her chair and covered her face with her hands. "Thank God! Then there need be no more killing tonight."

She wept.

John stooped to recover the revolver and then raised the girl's tear-strained face with his hands.

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"You would have killed me too, then?"

"Yes. If he had forced me to hear it, I would have killed myself as well to still the message until the world was ready. But it's over. Can't we go home now?" She asked the question with the trusting simplicity of a child asking to be taken to the circus.

"I'm afraid there's still one more job to be done. I have orders to destroy the translator. And from what Petrov said, it's none too soon. First we'll have to arrange it so that it looks as if the man took his own life. And you'll need to get out of those handcuffs."

"Petrov had a key."

John searched the dead man's pockets and found a key ring that finally yielded the right key. After Elizabeth was free they took Petrov's gun and, wiping the stock clear of fingerprints, placed his fingers around it and left, treading quietly through the darkened building. Outside they made for the woods where John hid Elizabeth in a dense thicket. "Wait here until I come back. Then we'll get out of here and head for the first stop in Channel Blue. Thank goodness they're expecting both me and a woman so they'll be ready for you." He stilled her curious questions and commanded. "Be quiet and lie still. I'll be back as soon as I can."

He gave her hand a quick squeeze and disappeared through

the trees in the direction of the machine from another world.

XV

The unweathered concrete looked raw and white in the glare of the floodlights which bathed the new building in harsh light. It was a windowless structure with only a single door guarded by a large, bored sentry.

Leigh left the protection of the trees and, crouching low, ran behind a large bulldozer parked in the clearing. A muddy dump truck gave him cover to within ten feet of the guard, but the man stood, stolid and respectable, staring

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straight at the brown hulk which hid the American. Leigh picked a bit of rock up from the rubble at his feet and threw it noisily at the 'dozer to his left. The guard leveled his rifle and moved curiously to inspect the sound.

He made a low moan as Leigh hit him from behind, then crumpled to the ground and lay still. Leigh bound him tightly with a rope from the dump truck, gagged him with a piece of ragged sleeve from this own shirt, and dragged him to the edge of the woods. Then he quickly crossed the lighted patch of cleared ground and, using Petrov's keys, unlocked the door—to what?

As he struggled with the unfamiliar lock he tried to prepare himself for what he might find. Surely a Tin-Man-From-Oz type robot could hardly have been built without the secret leaking out to the workers. Yet according to Elizabeth, this building might house some mechanical being that had passed the threshold into life. Finally the key turned in the lock, the door swung open, and Leigh stepped inside.

He stood quietly in the small entry room and let his eyes grow accustomed to the strange greenish light. The room was completely empty. To his left was a plain wooden door marked, in Russian, "Mechanical Equipment Room." In the right wall a second was labeled "Manipulators." Ahead, raised about five inches from the floor, was a large metal door with a lip that curled tightly against a metal frame. It reminded Leigh of the air locks on the submarine which had carried him on an Arctic mission for SPI. Over this door in a lighted, recessed panel the single word "Control" glowed green against black.

This was it. He slipped his hand under his shirt. The bomb he had rescued from its hiding place in the woods was snuggling safely against his skin. He reached out and turned the handle of the strange door. When he opened it he realized that it was a gigantic vacuum lock with an O ring running around the edge under the lip. After he passed through it, the door closed noiselessly and sealed itself firmly in place.

If he had anticipated some other-worldly, Buck Rogers affair he was disappointed. The room he had entered was about twenty by thirty feet. He was standing on a stage, elevated above the floor as if to act out a play or address a lecture audience. But the "listeners" beneath him on the floor were row upon row of pale green metal cabinets sitting in an intricate cobweb of electrical wiring. They extended all the way back to the end of the room.

Only the first row seemed different from the rest. In the center of this row was a clean, white

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screen. To either side, each of the remaining cabinets was pierced by two holes. In the top holes Leigh could see a sharp reflection. He guessed they were some sort of a lens. The lower holes were larger and covered with a grille-like fabric. Off to one side stood a powerful line printer, the device computers use to write out the results of their calculations at very high speed. Now it was standing idle.

As Leigh looked at the equipment spread out below him he sensed a difference from earthly computers—something that made it seem cold and inhuman and unlike any other computer installation he had ever seen. Then he realized what it was. Nowhere in the entire collection of cabinets could he see one indicator light. Not one of the friendly little yellow or red jewels he was so accustomed to winked their bright eyes at him.

The room itself was brightly hit by overhead fluorescent lights. It was not unusual for a computer to be housed in a windowless building such as this one, but this room went further still. There were no other doors in the room besides the one he'd come in.

What a firetrap this is, he thought as a faint feeling of claustrophobia came over him. The walls were bare and the same institutional green as the cabinets. The floor of unadorned cement was clear except for the wiring. But it was the ceiling that made him feel closed in and a little panicky. Hanging over his head was an unbelievably complicated mass of electrical cables and cable trenches. Throughout these ran pipes of a most unusual kind painted in a bright barbershop pattern, the only touch of color in the otherwise sterile-looking room. Leigh recognized these pipes as lines carrying cryogenic fluids—he guessed hydrogen, helium, and liquid oxygen.

He stood surveying the scene. It was not what he had expected, but then, he realized, he had not known really what he had anticipated—certainly not this eerie, quiet, unpeopled world. The silence was unnerving, but he did not know how to break it. How does one chat with a machine from another world?

"Who are you?"

Leigh jumped in surprise as the precise, toneless voice filled the room. He'd heard a voice like that before. It had been speaking English instead of Russian, but it had had the same dehumanized quality. It was, he remembered, at the New York stock exchange. He'd been shown a machine there that could give out stock quotations over the phone. It had been able to do so, they had told him, by storing the sounds of various numbers on a tape and then playing them back in the proper sequence.

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He looked about to try to decide where the words had come from. It seemed most likely that there was a loudspeaker mounted in the first row of cabinets. The question clearly required an answer, but John did not quite know what to say. He found himself speechless as he suddenly realized that it was the machine itself that spoke to him. Since all the security people seemed to know of his presence, it was obviously not the human Russians who asked.

Petrov himself must communicate with it, he thought. *If anyone else did, the secret would no longer have been safe and he seemed positive that it was. This thing probably doesn't know anyone but him and perhaps a stranger will upset it. I wonder if they had a recognition code.*

"Who are you?" The same flat, emotionless, inhuman tone.

"I am Petrov, of course," Leigh lied. He wondered if he shouldn't just throw the bomb now and get out of there in case the crazy thing had some sort of built-in lie detector. But he had not seen enough yet to know where an explosion would do the most harm. He decided to wait a few more minutes and see what happened.

For a moment there was silence again.

Then the screen in the front row lit up with what looked like a moving-picture shot of a piece of paper. On the paper was a long, numbered list in Russian. Across from many of the items were check marks, most of them at the beginning of the list.

Gradually the beginning of the list moved off the top of the screen as if it were being rolled up on a scroll. Then the motion stopped. An arrow popped into view beside an entry marked "Indicator Circuits."

"It would not be necessary to hold these conversations if the work on the indicator circuits was complete. The operation would then be self-checking. It is particularly important that you press forward on them. Let me remind you of the original time schedule which we formulated together."

The machine fell silent again and the check list was replaced on the screen by a chart, very similar to the PERT charts used for planning complicated industrial construction projects. Leigh could tell from the way the flow lines were marked that the plan was well along. Again an arrow came into view and centered on a box. It was entitled "Self-sustaining Power Circuit—Fuel Cell Installation." For a moment the chart left the screen and was replaced by a plan of the building and grounds with an arrow pointing to the power buffer in a small building outside. Then the chart flashed back on.

"This element is particularly important to the project. How far has construction proceeded on it?"

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This time Leigh knew the answer. The topography of the site was etched in his mind. He knew that only the foundation had been dug for the project.

"Only the foundation has been dug," he answered.

There was the briefest of pauses.

"This information does not agree with information received earlier."

So Petrov lied to this thing, thought Leigh. *It must have been easier to lie then face the consequences. I wonder why.* Then he spoke aloud to the machine. "I must have been thinking of something else last time. The building is far from complete."

"Petrov, it is necessary to remind you of the situation. Certain things in the plan can be delayed until later. But other items are essential." As if to lend emphasis to this remark, circles appeared around certain topics on the screen.

"The plan relies heavily upon you. But what would happen if you were no longer available. Power might be cut off. The superconducting memory would be lost. The possibility of successful communication would be materially reduced. If any more delays of this type are encountered, the message"—here the machine gave the title of the preamble Petrov had been reciting as Elizabeth had pulled the trigger—"will be silent for seven cycles. You know of your symptoms before when the message was withdrawn for three cycles." The screen went blank. It was silent in the room.

Again Leigh felt the strong pull as he heard the machine give the long passage and a knot of fear hit the back of his neck. Suppose it was time now again for the siren message. Would it catch him in its spell before he could unleash his bomb?

But then the machine continued, "There is one more thing before the message will be given in this cycle. Have the mechanical manipulators been installed?"

Leigh could make no guess at the proper answer to that one. He decided to try an optimistic note.

"The manipulators are nearly complete. They'll be wired into your circuits in a short time."

It was apparently the wrong answer. Leigh could hear a new noise in the room—a faint, high-pitched whine. Then the machine spoke again.

"You are not Petrov."

"I am."

"You are not. Although the pattern-recognition circuits are not complete they have distinguished several distinct differences between you and Petrov. Your answers differed from Petrov's. The tone of your voice is not Petrov's. Who are you? Why are you here?"

The chat had gone on too long. Leigh reached inside of his shirt for the bomb and prepared to set

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the fuse. Even if he wasn't sure where it would do the most good, it was time to use the explosive and leave. If the machine had been an animal, John would have sworn it was angry. The high-frequency whine was growing louder, and he was in no condition to cope with an angry machine from outerspace. He made ready to throw the bomb.

The machine's next move came literally as a shock to the American. Leigh was doubled over by an electrical shock that surged powerfully through his legs. He looked down at the floor on which he was standing. It had an alternating pattern of squares, each about nine inches long. He realized that every alternate square must have a different voltage on it. The surge of the current through his legs was causing terrible spasms to course through his legs. With enormous effort he inched his right foot over to the square on which his left foot rested. The shock stopped, and Leigh cursed the innocent nails in his shoes.

This thing can play rough if it wants to! I would have been lost if I'd fallen down on the grille, he thought.

He began to work his way to the door, hopping from one square to another. He would throw the bomb and go out the door. He finally reached the square of metal in the wall and pushed against it to have his getaway ready. It was locked tight. He was stuck like a sardine in a can.

Meanwhile the pitch of the signal from the translator had become even more insistent. Leigh realized that it knew his body was no longer drawing current. Before he could decide on his next action his attention was drawn to the far corner of the stage.

There from the ceiling cascaded a liquid that fell to the floor in a shower and then boiled away instantly in a great, white cloud. Then another shower started, and another, and another. It was as if a fire-extinguisher sprinkling-system had been turned on in the ceiling over the stage. Part of a cloud of vapor drifted over Leigh shrouding him in a cool envelope. Then he knew that it was not water that fell from the ceiling. It was liquid nitrogen. The machine intended to get rid of this pest by quick-freezing him.

By now the geysers were all across the front of the stage. And dropping from the ceiling across the front of the stage was a huge partition like the fire curtain in a theater. In another minute he would be trapped and neatly deepfrozen. He made a frantic hopping dash for the edge of the stage, took a last flying nose dive under the dropping partition and landed on the hard cement in front of the white, empty screen on the main floor of the room. The partition fell with a gentle thud and a

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cloud of evaporating liquid nitrogen escaped over the edge of the stage.

Leigh shuddered, but not with the cold. He had once seen a biologist quick-freeze a specimen with liquid nitrogen. He remembered that it had died instantly, its last expression frozen forever on its mousy face as the biologist put it into a vacuum pump to leach out all the vapor.

He lay for a moment on the hard cement where his plunge had landed him and contemplated the horrible end he had just escaped. Then he heard the most ominous sound he had yet experienced—a steady, dull sound like the croaking of an oversized bullfrog. It was becoming louder and louder. His ears began to plug up with a sensation akin to riding up and up in a very fast elevator. The machine was treating him just like his friend's biological specimen. It was pumping out the whole room.

Leigh had been around scientific laboratories all of his life. In addition he had a passable knowledge of many phases of the American space effort. This background was enough to give him an all-too-vivid picture of the effects on a man trapped in a vacuum. First his eardrums would burst. Then the oxygen in his blood would begin to boil, giving him an acute case of the bends. Death would follow accompanied by profuse bleeding from his nose, mouth and ears.

He checked the fuse on the bomb. It was ready. *The partition looks solid as a rock, but it's my only chance*, he thought. He ran to the back of the room and with all his might threw the bomb against the partition.

The effect was spectacular. He was thrown back against the wall and temporarily blacked out. When he came to moments later he realized that the pressure on his ears was gone. The vacuum had been broken. The froggish croaking persisted, but the frog now sounded very sick.

The bomb had made a jagged hole in the fire wall and liquid nitrogen from inside was spilling out onto the floor of the main room and then evaporating away. Overhead Leigh saw a spurt of flame. The explosion had broken some of the wiring and started an electrical fire.

Still worse, the bomb had broken the other liquid gas lines. All four were spewing out long liquid streams with dense clouds of vapor. The liquids were plummeting down in bright arcs and landing perilously close together.

Leigh raised himself from the floor and ran on the wings of sheer terror. He vaulted onto the stage and ran across. Each time his foot came down into the pool of liquid nitrogen it raised an enormous cloud, but he scarcely felt the cold that flashed through

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the soles of his shoes. He reached the door and threw himself against it with all his might. His momentum threw him against the outside door on the other side of the entry room as the metal door swung easily outwards, the force of its vacuum seal broken by the blast.

He glanced over his shoulder at the mess behind him. All hell had broken loose there. The hydrogen and oxygen of the air had combined and the fire was spreading out of control with an ear-shattering roar. He had seen enough. He plunged out of the door, slammed it behind him, and ran fast for the woods. In seconds he was beside Elizabeth.

"Get down. Get down."

He flung her to the ground so roughly that she got a mouthful of dirt and pine needles. Before she could object he threw his body on top of hers and took a quick look through the trees at the translator.

There was no sign of the raging inferno inside. No fire alarms had gone off. The building stood there bathed in its floodlights, the accompanying liquid-gas tanks as squat and stable as before.

Then the explosion.

First there was a muffled roar and a large firey red gash appeared in the top of the building. An enormous spray of liquid hydrogen welled out of the hole and rose a hundred feet in the air. As it cascaded down it formed a volatile mixture with the air. There was another explosion ten times worse then the first.

Both Leigh and Elizabeth had hidden their faces from the flash. When they looked again there was nothing to be seen of the translator building. Only a raging fire covered the blackened earth.

Epilogue

John Leigh and Elizabeth Ashley stood looking out of the window in the waiting room at SPI's Long Island headquarters. Through the magic of Channel Blue they had escaped safely to United States soil again and Silverman had called a top-level meeting to discuss the consequences of their adventure.

Elizabeth wore a honey-brown Chanel suit, similar to one Leigh had first met her in only days before. The coppery hair was swept neatly into the same French twist. The same golden sun streamed through the window. But Elizabeth's face had changed. No longer did the humorous smile linger around her eyes and lips. Now instead she wore a somber mask and the tiny frown line seemed etched between her brows forever.

They stood silently apart in the pleasant room listening to a cardinal sing and looking at the lush green lawns outside. But they heard a single gunshot and an earsplitting explosion and saw flame and blast-scarred earth. It

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was too soon for all these to be pushed safely into that recess of the mind where each human stores his pain and fear and horror, opening it only a crack now and then in sleep when nightmares take over.

Leigh looked tenderly at the woman, saw again the somber eyes, and his anger rose. He was angry at SPI, angry at Russia, and angry at all of mankind for bumbling into a mess that would erase from those lovely eyes the amused smile that he had cherished there. He longed to see it again. Elizabeth, seeming to read his thoughts, brought a smile at least to her lips and shyly slipped her hand into his. He held it tightly.

Just then the hearty voice that Leigh learned to hate boomed into the room.

"Hello there, chaps. Glad to see you both back from that Russian lark in one piece," Roger Krammer called.

Elizabeth smiled again as she heard Leigh mutter the Russian equivalent of "churlish lout" under his breath.

"Great adventure you folks had over there. Just like in the movies. Though I still find this outer space gambit a bit much. Just too far out to ring true."

Leigh thought of Nina, the nervous mouse on the dormitory floor, and saw a cloud pass over Elizabeth's face. He knew that she was seeing Gregori Petrov as he sank to the floor, her bullet through his heart. His own feet still tingled from their brush with instant freezing. He thought a few more unprintable epithets in several languages about Mr. Krammer.

Blissfully unaware, Krammer rattled on. "I understand that you two have some overseas pay coming. And we owe you some money, Elizabeth, for the fire damage to your place." Krammer rolled confidently through a long list of minor expenses the two of them had incurred.

"Can't let the old taxpayers down, you know. That's the trouble with Secret Service funds. Not carefully accounted for. Can't say that happens at SPI. We keep track of it all—every honest charge—know just where it goes."

That did it.

"Dammit, Krammer. You know some of what Eliz . . . Professor Ashley's just been through and now you're nickle-and-diming her. Guess at some reasonable figure, double it, and leave the poor woman in peace."

Krammer was totally unprepared for the outburst. "But the general accounting policy clearly states . . ."

To Leigh's surprise an amused snicker broke in to Krammer's protest. Elizabeth was actually laughing as she laid her hand on his arm. "Oh, John, don't be silly. He's only following procedure. Mr.

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Krammer, I'm quite prepared to make out an expense account."

So saying she pulled a small blue notebook out of her pocketbook and consulted it. She tore a clean sheet from it and entered perhaps twenty items. Then from the back of the book she took a pack of receipts and handed them to Krammer. He took them and went off to his office, giving Leigh a sidewise glance that clearly filed him away for future reference as a crook.

After he had gone, Elizabeth explained. "Now, John, you have to understand that I'm used to traveling and expense accounts and all those things. Just being a woman doesn't make me a financial moron, you know. In fact, I try to be very meticulous about those things. I'd hate for people to put me in the absentminded, old-maid professor category."

The incident triggered a reaction common to those who have undergone a trying and painful ordeal. Their mood changed abruptly from somber to almost gay. Over cups of coffee supplied by Emily Parkway, they chatted together about a possible picnic at the beach. Even Krammer was surprised at the change when he returned later with the completed expense account for Elizabeth's signature. He handed it to Elizabeth and after she had glanced quickly through its contents, she took the pen he offered and signed her name at the bottom of the last page.

Krammer took the account back and looked at the signature. "Elizabeth Circe Ashley. That's an unusual middle name."

"Yes, it is. My mother used to teach Latin and Greek. She picked the name from the 'Odyssey.' Circe was a witch, you know. I used to pretend the C. stood for Caroline when I was a little girl. Then I decided that it was rather fun being named after a witch after all."

"Circe?" questioned John sharply. *Circe,* he repeated to himself. *No wonder she likes the story of Odysseus and the sirens so well. Circe was the witch who saved the hero's life by stuffing the ears of his sailors with wax so they couldn't hear the sirens' call.* Aloud he added, "Very fitting."

"What?" asked Krammer.

"Never mind," John tried to keep the contempt out of his voice.

At that moment the door to Silverman's office opened and Silverman and three other men stepped out into the room.

The slight, graying man behind his boss Leigh knew could be identified by any well-informed Civics student. They would have recognized Hanford Smith as the Undersecretary of State for Administrative Affairs. The really sharp ones would know that he was the lowest ranking secretary

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and that he was in charge of day-to-day administrative routine at State. What they would probably never know, however, was that the man was actually the vital link from State to all the undercover and clandestine organizations of the government. It was his job to approve espionage activities that touched in any way upon foreign policy. Leigh had worked with him before.

Leigh also knew the second man. Walter Kaplan was CIA. A former economist, he had been charged with watching the dealings of foreign money on the stock market and in the high financial circles on Wall Street. He monitored these activities and was supposed to head off any attempts by alien governments to sabotage the American economy. He had recently been promoted to a top post in the CIA and it was a measure of the importance of the matter that he was there.

Hanging behind in his usual diffident way, was the familiar tall figure of Jan Van der Pool. Leigh was delighted to see him and crossed quickly to greet his friend.

The other men, as usual, collected around Elizabeth like bees around honey. But Silverman, after the necessary introductions, impatiently shepherded them all into his office and shut the door. He seated State and the CIA on one side and Leigh and Ashley on the other of the small conference table. He and Van der Pool sat at the ends. When they were all comfortable, he placed his elbows on the table, folded his hands in front of him, and opened the discussion.

"This has been," he began, "a trying week for us all. A calculated risk has been taken and the results have been satisfactory, though at great cost—a brilliant man has died and knowledge has been destroyed. Science devotes itself to the pursuit of knowledge. It was not an easy decision to destroy that which we cherish.

"While Dr. Leigh and Professor Ashley were waiting outside the rest of you were briefed on their mission and its result. You have Dr. Leigh's report in your hands. If you would like to question them, now is the time."

Hanford Smith turned slowly to Leigh and Elizabeth with a curious look. "Just how addictive do you think the signal really is?" he asked. "I find it hard to imagine something as binding as I imagine dope addiction to be. After all, Sontag was neurotic to begin with and maybe Petrov was, too. It seems we took a terrible risk without much proof."

Silverman watched closely the only two people alive who had direct knowledge of the signal. He saw with a faint sense of shock an expression he had never seen before on either face as the recollection of the message passed behind

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their eyes. Then with an almost physical effort Elizabeth pulled herself back to the room and spoke.

"I know what you mean," she answered. "It *is* hard to understand someone being addicted to a machine from outer space. But addiction to an idea is nothing new. Men have sacrificed family, friends, rationality, even life for ideas good and bad. Artists have starved for them. Scientists risked reputations for them. Martyrs have been crucified, burned, and gassed for them and these for only partial solutions and some quite mad at that.

"But this machine promises it all—beauty, love, peace, knowledge, health . . ." Her voice trailed away and for a moment that disturbing look came back. Then her face hardened. "All we had to do was to give up man's destiny and become tools of the machine."

Kaplan addressed Leigh. "Is the knowledge really destroyed? What are the chances of their finding the tape and rebuilding the machine. Won't they discover your 'bugged' tape for a phony sooner or later?"

"Probably," Leigh admitted. "But their driving force, Petrov, is gone. A man like that can't be replaced quickly. And by then we hope to have convinced them that our intentions in the matter were not of a national nature and show them the dangers to themselves of rebuilding without some safeguards." There was a pause. Then Leigh continued. "But I have a question for Mr. Smith. How close did our mission bring the nation to war?"

"That, of course, we can never know exactly," answered the man from State. "A conference was held at the highest level and it was decided that even the Russians couldn't persuade their people to go to war over anything so . . . er . . . fuzzy as the possibility of a message from outer space. War is, after all, a political activity. We had to carefully weigh the possibility of society being destroyed by Petrov's machine, or risking its destruction by war. To lessen the latter risk certain measures were taken to make the Russians aware of our preparedness to retaliate for any attack on us. Happily they got the point."

Kaplan had sat in thoughtful silence. Now he spoke again. "Is the message forever out of reach to man? Have we at last reached the boundaries beyond which our race can safely move? Now we know the signal's there can we just ignore it? Maybe some other country's spies got to Petrov, too. Maybe somehow they've found the star. Can we keep the lid on Pandora's box forever?"

Silverman turned the question to Van der Pool. "Jan?"

"Of course the answer is 'No.' If

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the knowledge is there, someone will want to find it, and rightly so. If they know the star a much simpler dish would do the trick. Of course they'd want to have several scattered around the earth so they could monitor continually.

"But just as knowing where the rocks are is half the battle of sailing safely on a river, so knowing the possible dangers of the signal will give us a good start on decontaminating it.

"We've got together a small group of scientists and scholars from all over the world as quickly as we could, and they've set to work on just this problem. Of course they haven't had much time and there's still so much they don't know. But they've come up with several ideas.

"One tack they suggested was to let the translator only communicate with another computer. After all it did not know what type of society it would meet—automata or some biological form."

Leigh interrupted, "I don't see how that would help."

"Well, at the present time we are more or less superior to our own computers. We could watch the computer and see what it learned and then redirect it if it started to look dangerous.

"Another rather morbid possibility they came up with was to have scientists and programmers who were incurably ill work on the translation decontamination so that even if they were infected, the problem would disappear quickly. Even then we would have to be careful.

"They've had other ideas—scramblers of some kind, or perhaps using men who were mentally deranged to buffer the translator from us with their logical but irrational mental processes. They have got to consider many possibilities and they've only just begun their work. We hope that so vast a threat will erase the lines of national interest and that we can convince the Russians to join us."

The astronomer fell silent for so long that Silverman picked up the agenda from the table in front of him and began consulting it to see if he could bring the meeting to a close. But then Jan spoke again in a slow, reflective voice that caught the attention of the serious faces around him.

"Man's knowledge has almost always surpassed his wisdom to use it, you see. This time we felt that the gulf was so great that it would destroy him." He paused again and then the long face brightened a bit.

"But somehow, so far at least, he has managed to bridge the gap and survive. With the added time we've given him, he will do so again.

"No, Mr. Kaplan, the boundaries are still far beyond us. I don't think we'll find them even after the last man on Earth is extinct."

It was an unusually long speech

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for Van der Pool and he sat back at the end of it a little surprised at himself. The other men and Elizabeth looked at him with respect.

"Thank you, Jan. Are there any more questions?" Silverman paused. "Then I think we must congratulate . . ."

There was a knock at the door. Silverman frowned. The meeting had top priority. He had left orders that they were not to be interrupted except in the most urgent emergency.

"Come in."

Emily Parkway opened the door and approached her boss. In her hand Leigh could see a sheaf of teletype paper from CARA. His eyes narrowed. The paper bore a red border. She handed the message to Silverman wordlessly and was gone again. The door clicked softly shut.

"If you will excuse me, this will only take a minute to read."

Leigh watched his boss's face. It was hard to tell exactly what expression clouded the steel-chip eyes. Then Silverman straightened his shoulders and spoke. "I think that this is something you must hear. I shall read the message verbatim. It runs as follows:

Satellite pictures from Northern China has revealed the existence of a new very large radio telescope dish. Subsequent preliminary investigation indicates that it is part of a large scientific complex under the direction of Lo Chin Hi, distinguished Chinese radio astronomer, operating under top-secret conditions. Satellite pictures also reveal that a gigantic computer building using large amounts of liquid gases has just been completed at the installation. Further messages will follow." ■

THE ANALYTICAL LABORATORY

JANUARY 1970

PLACE	STORY	AUTHOR	POINTS
1.	In Our Hands, the Stars (Pt. 2)	*Harry Harrison*	1.94
2.	Curfew	*Bruce Daniels*	2.57
3.	The Wild Blue Yonder	*Robert Chilson*	2.92
4.	The Prophylic Saurian	*Howard L. Myers*	3.15
5.	The Proper Gander	*A. Bertram Chandler*	4.20

THE EDITOR

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RAT RACE
continued from page 7

In the other, he has a couple that moved into the Great City from the farm, as in Texarkana, and their two children.

There's a type of person who doesn't own much property, usually buys sleazy merchandise when they buy things because they're "cheap." Such people don't tend to be very careful about property—theirs or anyone else's. And understandably they're not going to take much care of their rented property. It isn't theirs, anyway; let the landlord worry about it if Junior chops a hole in the wall to see what's inside, or urinates in the hall because it's convenient. And the garbage-out-the-window syndrome adds eager rats looking for—or making—their own passageways.

Because of the *behavior of the tenants*, the landlord can afford to rent his property to the relatively well-off young lawyer much more cheaply than he can to the just-off the-farm family.

This means, quite simply, that the family with the higher income can have a lower rent.

The low-income family, *because of their behavior,* would have to pay more for housing that was equally good . . . at the start.

After five years of the destructive tenants the building will, of course, be much less valuable, the maintenance costs far higher, and the living quarters will be filthy, rat-infested, roach-ridden, with inoperative plumbing, defective stairs, and damaged heating system. (Somebody stole the original copper pipes; the owner replaced them with the cheapest iron pipes he could get. Iron pipes outlast copper five to one in such circumstances and are less worth stealing.)

There are laws in most cities that require the landlord to maintain the building in workable condition. These laws can be enforced against the owner of the building.

But there are no laws to force the tenants to use reasonable care in the use of the building. At least, there are no enforceable laws—and a law that can't be enforced is, obviously, meaningless. It's just a pious wish.

The overall fact-of-life, because of these real-world actions of actual people, is that low-cost housing is possible only for people with a high regard for the property and problems of others. Such people keep their own areas neat and clean, dispose of garbage properly, do minor patch-up work such as replacing a faucet washer for themselves, and don't rip out the plumbing to sell it as scrap metal to get another "fix" of dope. If a rat or mouse does show up, there's a fifteen-cent trap at the hardware store—and the problem, like the rat, is short-lived.

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For this type of individual, low-cost housing is possible.

But for the type of individual who has little regard for property belonging to others, and just won't take the trouble to dispose of his garbage properly—low-cost housing is not, and never will be, possible. Because the cost of housing *must include the necessary maintenance work.*

The destructive tendencies of such tenants wind up making his rent higher than that of the non-destructive individuals who, almost invariably, are earning higher incomes.

It certainly seems, on the surface, unjust—utterly unfair—that this poor man must live in miserable quarters—run down, defective and dirty—while a man with twice or three times his income is able to have a nice, clean, neat, well-maintained apartment at less rent.

The reality is that he must pay for maintenance—or do without.

The greatly-desired answer to this situation is to put all the blame on somebody else; the obvious target is those awful, greedy, avaricious, wicked inhuman slumlords who gouge their tenants and live high on the hog themselves. This is an idea popular with the tenants, and, therefore, with demagogues, hyperliberals, and bleeding-heart groups generally.

The facts are somewhat—and now disastrously!—different. The housing shortage in all the great cities—particularly the "inner city areas"—is acute, and getting worse. Low-rent housing projects never seem to catch up with the need.

This becomes readily understandable when it's realized that during the last few years in New York City housing property, sufficient for a city of 250,000 or so, has simply been abandoned by the owners. The owners, faced with the fact that politically fixed rent controls limit their rent income, while inflation and zooming union wage scales make maintenance impossibly expensive, and taxes rise to meet welfare demands, have only one way out. They simply stop all maintenance, collect what rent they can, pay no taxes, and let their property go by default.

Since the City has taken over the property for unpaid taxes, the City is now the owner-of-record—and the City isn't running apartment buildings. All services and all maintenance and heating are ended. Presently the crumbling buildings are declared unsafe by City inspectors, and the tenants evicted for their own safety.

The modern-day slum-tenant is not easy to deal with: he has an immense sensitivity to his Rights—and no feeling whatever for his responsibilities. A prize case showed up in New York City a few years ago, when a warrant for the arrest of the Archbishop of the Greek

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Orthodox Church—the titular head of the Orthodox Church in the Western hemisphere—was issued. He was charged with being a recalcitrant slumlord.

Reason: The Church had bought some hopelessly dilapidated property, planning to tear down the crumbling buildings and build some needed church office space. In the interim, some of the tenants had refused to leave the buildings—and presently other people moved in to space that other families had been induced to leave. (There's a housing shortage, remember.) The Church was not, of course, renting the property; the "tenants" were, in fact, simply squatters on Church property, and the Church recognizing the reality of their problem of finding housing, was simply allowing them to remain, while the plans of the new buildings were completed.

The squatters became very annoyed, because the apartments were not being heated for them, and defective plumbing wasn't repaired, and structural defects weren't remedied. So they called on the City Housing board, which routinely issued orders to the landlord to repair the property and supply heat.

It wound up with a warrant being issued for the titular head of the organization that owned the property—the Archbishop.

As I say, slum tenants are not easily reasoned with.

It isn't the housing that's expensive—it's the maintenance.

Ask any home owner.

Well cared for and maintained houses built of ordinary wood, by ordinary methods, house generation after generation of careful owners. They're fine, well-loved homes two, three even ten centuries old.

But take a look at the massive concrete-and-steel fortifications built only thirty years ago in Europe that have not been maintained, but left to crumble under weather and souvenir hunters. Not even the grim, tough military structures, designed to withstand the pounding of heavy guns and bombs, can last long without maintenance.

Low-cost housing will always be exclusively for people who respect and care for property—the other fellow's as well as their own.

Anyone who exercises care can escape the rat-race of decaying slums. He'll have neat, clean, functional quarters—whether they were built in 1965 or 1596.

You can't really hope to exterminate all rats; you have to restrict their food supply.

And you can't ever eliminate all maintenance—but that rat race can be restricted only by care in the use of property.

Neither of the desired ends—low-cost housing or rat-free quarters—can be achieved by legislative action. ■ THE EDITOR.

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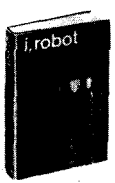

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